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LEARNING AS WE GO

GOVERNMENT by experiment has one advantage over the more orthodox processes of legislation, adjudication, and administration. When mistakes are made and we are wise enough to recognize them, they can be corrected without the formalities of constitutional amendment. Right now it is interesting to note in Washington some rather surprising but wholly desirable reversals of opinion and policy. One of these is a budding recognition of the futility of attempting to restrict output or production capacity. Another is the wavering support being given to the idea that higher prices, even if artificially created, will be of universal benefit. More important than either of these, is the slight hint that perhaps, after all, the profit system needed only a little spanking and some of the plans for social reform had better wait until industry can pay its bills and put some money into the Treasury.

The annual report of the du Pont company contains a trenchant reference to governmental restriction: "It is quite obvious that our material wants cannot be permanently satisfied by a prolonged limitation of the productiveness of our plants and man-power, nor can the hunger of our people be satisfied by the destruction or restriction of the products of our farms." The committee of economists appointed by Columbia University which has just reported after more than a year's study of means of emergence from the depression makes this recommendation: "In the administration of the recovery program, special care should be taken to insure that code-making facilities shall not be made a means for the competitive limitation of output by organized industries." Even in prosperous times, according to this committee, we do not "make the most effective and economical use of the capacity which modern inventions, resources, and power place at our disposal."

But are such views likely to be accepted in Washington? There is reason to believe they will be soon if they are not already acceptable. The recovery program has reached the stage where, if employment and purchasing power are to be extended, there must be an expansion of volume of production. The heavy industries that have been the laggards in the procession must be brought up to the line of march. This means capital investment in new plants and processes. In fact one of the closest students of the current situation, Dr. Lionel D. Edie, holds that the ultimate success or failure of the New Deal depends in a large measure on the revival of the capital goods industries.

The problem of prices has political as well as economic ramifications. Already there is evidence of a growing revolt against the rising cost of living, which will not go unnoticed by those politicians who have their eyes on the November election. General Johnson's famous nine-word warning, "Keep prices down, for God's sake, keep prices down!" was directed primarily at manufactured goods, not farm products. He realizes only too well that a general rise in prices without further increase in demand for goods is the surest way to lessen that demand.

The most important lesson is yet to be learned in Washington. The bill for all the fun we are now having must some day be paid and directly or indirectly industry must provide the funds. Every additional burden that is placed on industry, everything that is done to make it more difficult for a business to earn a profit, merely postpones the time when we can throw off the costly yoke of paternalism and government subsidy.

EDITORIALS

After the Code, What?

FIVE months after its public hearing the code of the Chemical Manufacturing Industry, received, on Feb. 10, the approval of the President and thereby became the law of the land. Its final form, as published on the opposite page, differs somewhat from the first draft that appeared in *Chem. & Met.* in August, 1933. Primarily, however, it is still a wage-and-hour agreement and among codes is almost unique in that it contains practically no provisions for improving trade practices. Nevertheless the machinery is now definitely set up and it remains for the industry to decide whether or not it is going to follow through the start that has been made in the direction of cooperative effort.

Correspondence received since our publication last month of the summary of views on "Selling Chemicals by Code" leads us to believe that the industry is of two minds on the desirability of drawing up these supplementary codes of trade practices. One group of companies advises against asking any favors of the government, apparently feeling that these may later lead to retaliation through restriction of profit or further regimentation of industry. The other group, made up of the smaller companies, sees an opportunity to rid the industry of certain bad practices by establishing fair differentials and sounder pricing policies. They see what has been accomplished in other fields and naturally wonder why the manufacturers and distributors of chemicals should hold back when such an opportunity is offered.

It is our feeling that for some time to come industry and government are going to operate through the instrumentality of these codes. Those industries that have set up their standards and have gained valuable experience in enforcing them will have an advantage which others might well envy in the event of a price war or a wave of unfair competition.

Fritz Haber Dies in Exile

IN A LIST of the leaders of Germany's industrial recovery after the War, published in 1926, a leading place was accorded to Professor Fritz Haber, director of the Kaiser-Wilhelm Institute for Physical and Electro-Chemistry. Eight years before, he had been awarded the Nobel Prize in chemistry for his revolutionary contribution of the nitrogen fixation process that bears his name and that of Dr. Carl Bosch. But last year, because he was both a Jew and a pacifist, he was forced by the Nazis to resign from the directorship which he had held since 1911. When he died suddenly in Basle, Switzerland, on February 1, the Berlin papers reported that he was "traveling and lecturing" although his friends in this country hold that he was actually a man without a country.

Such is the sad commentary on an ungrateful government. The closing days of a life that probably contributed more to the practical advance of German science, agriculture and industry than any other, must be spent in exile while a flamboyant corporal struts his hour upon the German stage. Both lives will undoubtedly have their place in history, but it is at least interesting to speculate on what would have happened to Hitler and his party had it not been for what Haber contributed to the sinews of both war and peace.

Supreme Court Shows The Lay of the Land

ONE of the outstanding judicial decisions of recent years was rendered by the Supreme Court of the United States on Jan. 8, when it confirmed the right of the State of Minnesota, by legislative procedure, to declare a mortgage moratorium in the interest of stabilizing the economic structure of the community at large. Thus the court declares that the rights of society collectively are greater than the contract rights of individuals considered separately.

One can rightly infer from this momentous decision that the Supreme Court will find no fundamental reason why the Federal Government may not proceed to meet economic difficulties with radically new economic agencies, so long as it is demonstrable that the welfare of society as a whole is at stake. There is thus laid in an orderly fashion a judicial basis for the continued development of the alphabetical agencies in Washington, so long as they remain within the compass of reasonable action.

Non-Food Products From Agricultural Materials

NEW USES for agricultural products are urgently needed. This is the sole justifiable ground for the argument in favor of "alky gas." The disadvantages of that development were, however, so obvious as thus far to defeat its further advancement. Other like possibilities have not been adequately explored.

Based on this philosophy it was proposed that the Agricultural Adjustment Administration take as a part of its program the investigation of new methods for using the products of agriculture, particularly the manufacture of new industrial materials by chemical processes. There was a division of opinion within the Administration as to the propriety of this course. The opposition was sufficient to defeat the plan.

Chemical engineers recognize that any such program necessarily could not be carried to full fruition within a very short time. It may, therefore, have been a proper decision to eliminate chemical engineering research from the A.A.A. emergency program. But this does not in any way reduce the importance of the results to be sought or the urgency of making a start. Ultimately farm relief would be greatly advanced by any new uses for agricultural products. This phase of the Government's responsibility should have greater stress. And industries should be alert to the possibility of doing research themselves with such an objective in mind.

APPROVED CODE OF FAIR COMPETITION FOR CHEMICAL MANUFACTURING INDUSTRY

TO effectuate the policy of Title I of the National Industrial Recovery Act, the following provisions are established as a Code of Fair Competition for the Chemical Manufacturing Industry.

Definitions—(a) The term "President" as used herein means the President of the United States.

(b) The term "Administrator" as used herein means the duly appointed representative of the President to administer the National Industrial Recovery Act.

(c) The term "Chemical Industry" as used herein and covered by this Code, shall be defined to mean the production and sale by the producer of heavy, industrial and fine chemicals, and their by-products, unless separate codes not supplementary to this Code are submitted by any division or sub-division of this Industry and approved by the President.

(d) The term "Alliance" as used herein means The Chemical Alliance, Inc., a non-profit sharing corporation organized and existing under the laws of the State of Connecticut. A copy of the Constitution and By-Laws of said corporation is attached hereto marked "Appendix A."

(e) The term "employees" as used herein means all persons employed in any phase of the Chemical Industry covered by this Code.

(f) The term "effective date," as used herein, means the tenth day after this Code has been approved by the President of the United States.

Hours of Labor—On and after the effective date, no person, including accounting, clerical, office and sales employees, employed within the Chemical Industry shall be permitted to work more than an average of forty hours per week during any period of four months nor more than forty-eight hours during any week, but such limitations shall not apply to:

(a) Any person employed in an executive, administrative, supervisory and/or technical (not to include skilled operating labor nor non-professionally trained, laboratory workers) capacity, or as an outside salesman.

(b) Any person employed as repairman, engineer, electrician, loader, truck driver, cleaner or watchman; provided that, no person specified in this sub-paragraph (b) shall be permitted to work during any three months' period more than an average of forty-four hours per week nor more than forty-eight hours in any one week.

(c) These departments or divisions of the Chemical Industry in which season or peak demand places an unusual and temporary requirement for production upon such departments or divisions, except that in such cases no employee shall be permitted to work during any three months' period more than an average of forty-four hours per week nor more than forty-eight hours in any one week.

(d) Employees engaged on continuous operation at places where adequate supply of qualified labor is not available and cannot reasonably be made available and where restriction of hours of such employees would unavoidably reduce production. In such cases the average weekly hours may not be in excess of forty-eight hours per week and at the end of each calendar month any such employer in the Chemical Industry shall report to the Alliance, in such detail as may be required by the Executive Committee or the Administrator, the number of man hours so worked, giving the reasons therefor, and the ratio which such man hours bear to the total number of man hours during said month.

(e) Cases of emergency, provided that at the end of each calendar month any such employer in the Chemical Industry shall report to the Alliance, in such detail as may be required by the Executive Committee or the Administrator, the number of man hours so worked, giving the emergency reasons therefor, and the ratio which such emergency man hours bear to the total number of man hours during said month.

Minimum Wages—On and after the effective date the minimum wages paid by any employer in the Chemical Industry to any employee, including accounting, clerical, office and sales employees, shall be not less than thirty-five cents per hour when employed in the Southern District as defined below, nor less than forty cents per hour when employed elsewhere in the United States; provided, however, that if the hourly rate for the same class of work on July 15, 1929, was less than thirty-five cents per hour in the Southern District or less than forty cents per hour elsewhere in the United States, then in that case the minimum wages paid hereunder shall be not less than the hourly rate paid on July 15, 1929, and in no event less than twenty-five cents per hour in the Southern District and thirty cents per hour elsewhere in the United States; provided, however, that where a State law provides a higher minimum wage, no person employed within that State shall be paid a wage below that required by such State law. The above provisions shall apply in all cases except that

(a) Apprentices and learners for not more than the first six months of employment shall be paid not less than eighty percent of the minimum wages above provided and the total number of apprentices and learners shall not exceed five per cent of the total number of employees employed by any employer subject to this Code.

(b) Employees who because of age or infirmities are employed in such positions as watchmen, gatemen, caretakers, etc., shall be paid not less than eighty per cent of the minimum wages hereinbefore provided and the total number of such employees shall not exceed five per cent of the total number of employees employed by any employer subject to the Code.

For the purposes of this Article "Southern District" shall be defined as that territory south of the States of Maryland, West Virginia, Kentucky and Missouri, and including the States of Oklahoma and Texas.

Child Labor—On and after the effective date, no employer in the Chemical Industry shall employ any person under the age of sixteen years: provided, however, that where a State law provides a higher minimum wage, no person below the age specified by such State law shall be employed within that State.

Administration—The Alliance is hereby appointed an agency for the following purposes:

(a) To collect from the members of the Industry all data and statistics in relation to number of employees, hours of labor, and rates of pay necessary for the administration of the provisions of this Code which may be called for by the Administrator. Any data and/or statistics of a confidential nature shall be collected and compiled by a firm of Certified Accountants or other suitable agents selected by the Alliance and not a member or connected with a member of the Chemical Alliance. The data and/or statistics so collected by such agents shall be furnished to the Alliance only in combination with other information of the same type and in such form as will not disclose the individual data or statistics furnished by any single employer. No officer or director of the Alliance or any other person or agency shall at any time have access to or be furnished in any manner with any information by said agents which would disclose the individual data or statistics furnished by any single employer.

(b) To represent the Chemical Industry in conferring with the Administrator with respect to the application of this Code and of said Act, and any regulations issued thereunder, and receive complaints, and if possible adjust the same, and to coordinate the administration of this Code with such codes, if any, as may affect any sub-division of the Chemical Industry, with a view to providing joint and harmonious action upon all matters of common interest, and to receive any proposals for supplementary provisions or amendments of this Code and transmit the same to the Administrator; provided, however, that as regards all matters mentioned in this paragraph (b) said Alliance shall not have the power in any way to bind the Chemical Industry or any sub-division thereof.

(c) The duties of the Alliance above enumerated shall be performed by its Executive Committee. The President may name three representatives who, without expense to the Alliance or the industry, shall have the right to attend all meetings of said Executive Committee dealing with questions concerning the administration of this Code but such representatives shall have no vote.

(d) Nothing contained in this Code shall constitute the members of the Alliance partners for any purpose. Nor shall any member of the Alliance be liable in any manner to any one for any act of any other member officer, agent, or employee of the Alliance. Nor shall any member of the Alliance exercising reasonable diligence in the conduct of his duties hereunder be liable to any one for any actions or omissions to act under this Code except for his own wilful misfeasance or non-feasance.

(e) The Chemical Alliance shall: (1) Impose no inequitable restrictions on membership and (2) Submit to the Administrator true copies of its Articles of Association, By-Laws, regulations and any amendments when made thereto.

All members of the Chemical Industry shall be entitled to participate in and share the benefits of the activities of the Chemical Alliance by becoming a member of the Alliance, or by complying with the requirements of this Code and sustaining their reasonable share of the expenses of its administration. The reasonable share of the expenses of administration of each member of the Industry shall be determined by the Alliance on the basis of the total number of employees covered by this Code, as provided in the Constitution and By-Laws of the Alliance or, subject to the approval of the Administrator, on such other equitable basis as the Alliance from time to time may determine.

If any employer in the Chemical Industry is also an employer in any other industry, the provisions of this Code shall apply to and affect only that part of the business of such employer which is a part of the Chemical Industry.

Employee Organization and Bargaining: (a) Employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint or coercion of employers of labor, or their agents, in the designation of such representatives or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection.

(b) No employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing, or assisting a labor organization of his own choosing.

(c) Employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment, approved or prescribed by the President.

In all activities under this Code, the peculiar relation of the Chemical Industry to national defense, national health, national industry and national agriculture must be constantly borne in mind by its employers, stockholders, directors, executives and employees. The present products of this industry should be regarded as only byproducts; its main product and purpose the extension of chemical knowledge in the public interest. It is recognized that the Chemical Industry, if it is to keep abreast of chemical progress in the world, requires employees capable of constant advancement in their technical skill and of high and loyal character. Therefore, conscious of the great purpose of the industry, by presenting this Code the employers in this industry shall not be deemed to have waived any of their constitutional and legal rights to engage, promote or release employees, and the members of the industry shall not be deemed to have waived any other constitutional rights.

The President may from time to time, cancel or modify any order, approval, license, rule or regulation issued under Title I of the National Industrial Recovery Act.

Supplementary provisions covering fair trade practice rules, applicable to sub-divisions of the Chemical Industry, may from time to time be submitted by the agency designated herein, or by an agency named by any sub-division, for the approval of the President. Notwithstanding any provisions of Article V, or any authority conferred thereby, any sub-division shall have the right to and shall be entitled to submit in its own behalf, direct to the National Recovery Administration, and to administer, such supplementary provisions concerning fair trade practice rules, providing that no such supplementary provisions shall be inconsistent with the purposes and provisions of this Code.

Subject to the approval of the President any sub-division of the Chemical Industry operating under the provisions of this Code may elect to sell any of its products only upon open prices and/or terms and conditions publicly announced by each member of such sub-division. Any changes in prices and/or terms and conditions by any member of such sub-division shall be announced by such member immediately to all other members of the sub-division through such Agency as the sub-division may determine. Variations from such open and publicly announced prices and/or terms and conditions shall not be allowed.

By presenting this Code, and the specific provisions of Articles II and III hereof, those who have assented hereto do not thereby consent to any modification thereof, except as each shall thereto subsequently agree.

Except as to temporary exemptions or stays arising by reason of the operation of the Executive Order of July 15, 1933, any exemption or stay of application from the provisions of this Code shall be granted by the Administration only after submission of the application to the Alliance and the expiration of a reasonable time within which to permit the Alliance to submit recommendations thereon. It shall be the policy of the Administration in granting any exemption or stay of application that no distinction shall be made between the person or persons requesting such exemption or stay of application and other persons similarly situated in the Chemical Industry.

The Code shall continue in effect for a period of ninety days after the effective date thereof, subject, however, to amendment at any time as hereinbefore provided, and also subject to the reserved power of the President to cancel or modify his approval thereof. The Code shall continue in effect after the expiration of said period of ninety days in the absence of such reserved power on the part of the President, or in the absence of the exercise by members of the Alliance of the power which they hereby reserve, to terminate the Code at any time after the expiration of the said period of ninety days. Such cancellation shall be proposed by the Code Authority by vote of the majority of members thereof at the time in office. The proposal to cancel shall then be submitted to all members of the Chemical Alliance who shall be given a right to vote thereon. If at least two-thirds of the votes entitled to be cast by the members of the Chemical Alliance, in accordance with the provision of Article VIII, Section 5 of the Constitution and By-Laws of the Chemical Alliance shall be in favor of cancellation, the Chemical Alliance shall have the power, after service of a thirty day notice on the Administration, to terminate said Code. When so terminated, all subsequent liabilities and obligations hereunder shall cease. Notwithstanding such action by the Alliance, any sub-division of the industry may elect to continue the Code in effect as to itself.

CONTROLLING

Atmospheric Conditions in

IT HAS BEEN well stated that the successful rayon producer is successful only so long as he is able to control the chemical processes in his plant. This is really only possible when the atmospheric conditions in the plant are controlled.

In some parts of the process to be described, temperature control is necessary in order that the proper degree of aging of the chemical compounds may be obtained. In other parts of the process control of both temperature and humidity are required. In parts of the plant exhaust systems must be installed to remove objectionable gases, and the air introduced into these rooms to replace the air which has thus been exhausted must be controlled and properly conditioned. In fact, it is practically impossible to control the temperature and humidity in a rayon plant without the use of properly designed air-conditioning equipment.

The Covington, Va., plant of the Industrial Rayon Corp. is an example of well-controlled operation by air conditioning. It represents one of the most modern installations of equipment for the production of viscose rayon. This plant was the first in this country, producing by the spool spinning method, to operate with an increased size bobbin. The advantages to be gained from the use of this method are greater length of thread per bobbin with greater uniformity resulting in increased efficiency and economy. Also, it was the first plant to use downward exhaust on spinning machines.

The productive capacity of the plant, when the floor space in every building is included, is about 24¼ lb. of rayon per year per sq.ft.; or a production of 9,700,000 lb. per annum on only 400,000 sq.ft. of floor space. The product includes rayon yarns ranging in denier from 450 to 30, both in lustrous and low lustrous types.

As has been demonstrated at the Covington plant the efficiency of a rayon plant to a large extent is due to the economy which is practiced in its design and construction. This plant was built at a cost of about 78c per lb. per yr. capacity and has an initial advantage of comparatively low fixed charges per pound of product manufactured.

Distribution of production costs in the rayon industry is as follows: raw materials and chemicals, 38 per cent; labor, including maintenance, 41 per cent; and fixed charges, including maintenance other than labor, 21 per cent.

Water for process use comes from Potts Creek which has a minimum flow of 10,000,000 gal. per day, of which 3,000,000 gal. is used. Water is pumped to the treatment plant adjacent to the chemical building where the mineral matter is coagulated with aluminum sulphate, settled, and filtered by gravity through sand beds. The pH of the water is then accurately adjusted at 7.6 in the clear well, because of its influence on the efficiency of the water in the process operations.

This plant is in an unusually fortunate position in regard to waste disposal which is by means of the nearby Jackson River. The industrial waste consists chiefly of dilute solutions of sodium bisulphate which tends to purify the water of the river previously contaminated with, among other things, large quantities of waste products derived from the production of pulp and paper by the sulphite process. The subsequent addition of the acidic wastes causes the formation of a finely divided

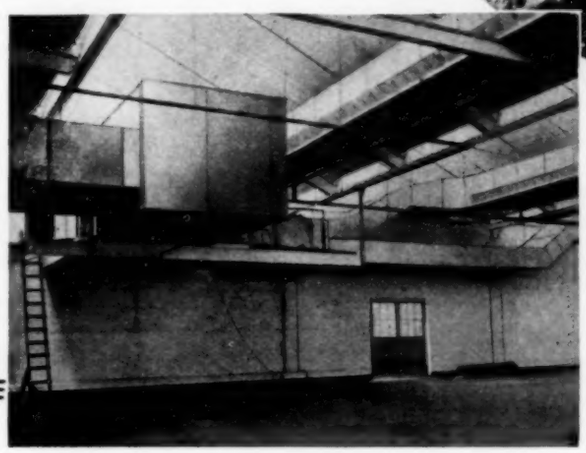
After the sheets of cellulose are treated with alkali they must be shredded and ground to form crumbs

RAYON PRODUCTION

By JAMES A. LEE
Managing Editor of Chem. & Met.

The Covington, Va., plant of the Industrial Rayon Corp. is an example of well-controlled operation by air conditioning. It represents one of the most modern installations of equipment for the production of viscose rayon

Covington, Va., plant of the Industrial Rayon Corp.



Heating units and other air conditioning equipment in one of the spinning rooms in the Covington plant

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gelatinous floc of cellulosic products resulting in clarification of the water.

In this Virginia plant the basic raw materials consist of a combination of sulphite wood pulp and cotton linters. A three-months' supply, based on the operation of the plant at capacity, is kept on hand in the pulp-storage building, the small building near the filter beds appearing in the accompanying illustration. Nearby are the tanks for the storage of carbon bisulphide, sulphuric acid, and liquid caustic soda. The bisulphide tanks are totally immersed in water pits to minimize explosion hazard.

The viscose solution is prepared in a five-story building and the various steps in the process are so arranged that full use is made of gravity in handling the compound during the several stages in its processing. The pulp, the only solid material handled, is transferred from storage to the top floor by means of an elevator; the caustic soda is pumped to the dissolving and mixing tanks located on the top floor, where the two solutions of different concentrations are prepared. From this point they are distributed by gravity to the stations where they are used.

The fifth floor also contains the steeping presses in which the pulp-linter sheets are immersed for two hours in an 18 per cent solution of caustic soda. When the mercerizing is completed and the pressure has been released the operator drops the sheets through chutes directly into Werner & Pfleiderer shredding and grinding machines on the fourth floor. The alkali cellulose in the form of crumbs is transferred through chutes to large movable steel storage "cans" in the aging room below.

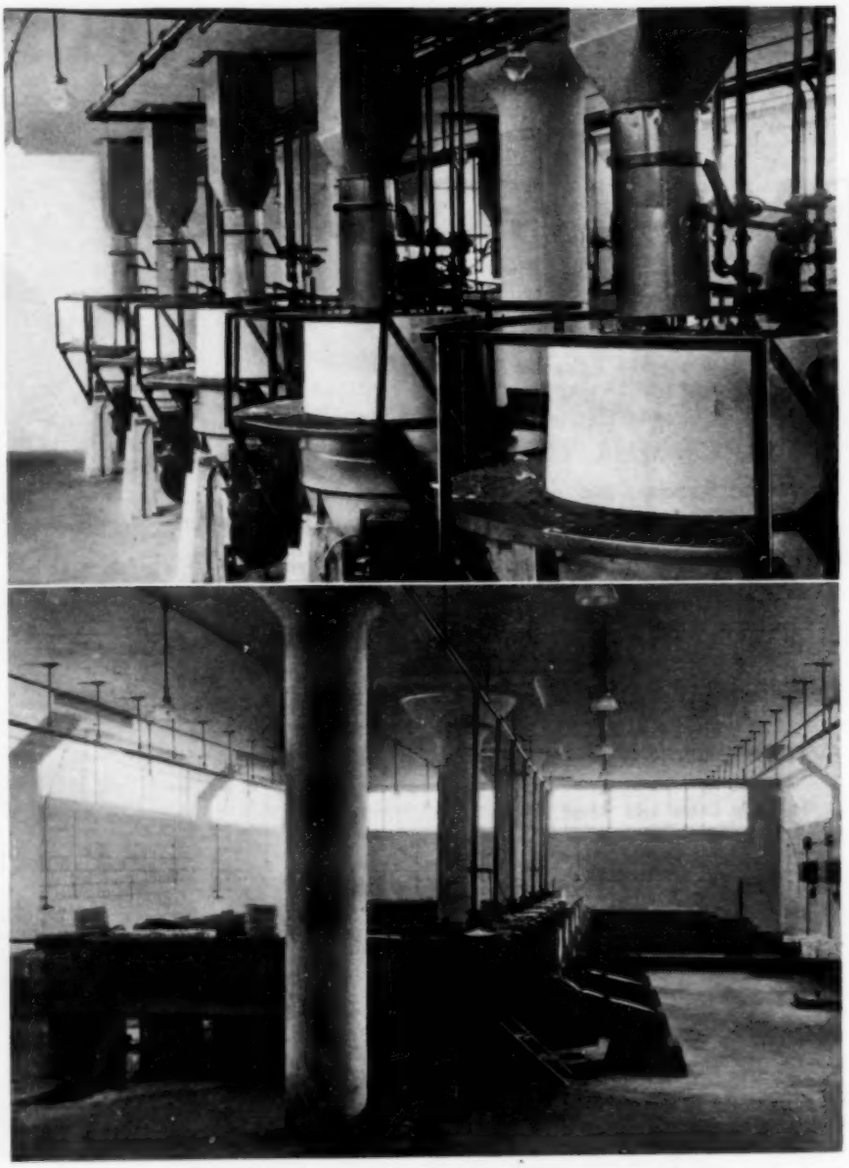
After aging for 48 hr. at a constant temperature the soda cellulose is discharged through chutes in the floor directly into the revolving churns on the floor below. Here the mass is acted upon by carbon bisulphide which converts it into sodium cellulose xanthate. Upon completion of the reaction the gelatinous mass is dumped into the high-speed Baker Perkins dissolving mixers on the first floor where the viscose solution is finally obtained by dissolving the mass in a dilute solution of caustic soda. The viscose is then run by gravity into accumulating tanks in the basement and finally transferred by air pressure to the ripening cellar in the basement of the main building, under the spinning room.

The viscose solution is evacuated to remove all traces of incorporated and dissolved air and blown three times through Shriver plate-and-frame filter presses which remove particles of undissolved cellulose xanthate and solid contamination.

When the viscose has been ripened sufficiently it is blown by means of compressed air to the spinning machines located immediately above. Here it is converted into thread, the continuous length of which weighs about 0.6 lb. The full spools of yarn are put into vacuum wash boxes where the adherent solution of sodium bisulphate is thoroughly washed out by hot water.

As previously mentioned downward exhaust is used on the spinning machines to remove the fumes. The exhausts are covered with lead sheet and the ducts are concrete.

The yarn intended for an unbleached product, while still wet, is placed in other troughs and treated by ammonium sulphide to remove the adherent colloidal sulphur. The yarn is then passed through long Proctor & Schwartz drying tunnels where the moisture is reduced from 150 to about 3 per cent on the dry basis. It is subsequently increased to the normal 10 per cent. This thread is then given a low twist of between three and seven turns, wound into cones, inspected, graded and packed for shipment, while the yarn which was not desulphurized is wound into skeins, bleached, dried, graded, and packed for shipment.



Steeping presses in which the pulp-linters sheets are immersed in caustic soda
Above—Dissolving mixers in which viscose solution is obtained

Conditioning of the air in the chemical department is limited to the control of a low temperature on the third floor and basement where the soda-cellulose and viscose solution are aged. The cooling is accomplished by means of brine lines. No attempt is made to control humidity in these rooms. Cold brine and cold water are supplied by a refrigerating plant located in the basement of the power house. Refrigerating equipment includes three horizontal enclosed type double-acting ammonia compressors direct connected to welded-frame synchronous motors.

Brine from the process departments is cooled in two shell and tube coolers located near the ammonia condensers and forced into the line by a centrifugal pump. The water circulated in the process equipment is cooled by brine circulated through coolers in the mill basement.

The excess carbon bisulphide and other vapors are removed during the processing by two horizontal vacuum pumps. Motors are connected to these pumps by Texrope drives. Water for the various mill purposes is handled by the general-service centrifugal pumps in the power house basement.

Conditioning of the air during the spinning, twisting, bleaching, and drying and finishing is not as simple as in the chemical department for both temperature and humidity must be controlled. During these steps in the process the rayon fiber is very hygroscopic and therefore sensitive to the moisture in the atmosphere. In case the humidity in the air is very low, the fiber may become too brittle to be properly processed; if the humidity is very high, the fiber may absorb sufficient moisture to affect its strength. Therefore, close regulation of temperature and humidity is necessary through the processing.

There are two spinning rooms, two twisting rooms, and one finishing room. To condition rooms where spinning and twisting operations are carried out is largely a problem of humidification. (For a detailed description of the air-conditioning equipment which was designed and installed by the Carrier Engineering Corp. refer to *Power*, p. 328, Aug. 27, 1929.) These rooms

are equipped with individual air-conditioning units, including air washer, fan, fresh-air filters, heating stacks, and air-washer pumps. In each conditioning unit a portion of the air drawn from the room, together with filtered fresh air, passes through the air washer, and at the washer outlet the remainder of the air from the room mixes with the washed air. The proportion of return air that does not pass through the washer is controlled by dampers under the regulation of a hygrostat. The quantity of fresh air passing through the washer is controlled by the temperature of the air leaving the air washer. The combined recirculated air and washed air is forced by the fan through the system of ducts to the room being conditioned.

After the rayon leaves the twisting department it is necessary to set the fibers in their new position. This is done by softening the yarn under required conditions of temperature and humidity which removes all strains and stresses set up in the twisting operation. After the softening process the rayon is dried and the fibers are thus set in their new relative position. From here the rayon is ready to go to the reeling department.

In cold weather the conditioning equipment will maintain a temperature of 70 deg. and a humidity of 75 per cent in spinning and 60 per cent in twisting rooms. In summer a wet bulb temperature 9 and 16 deg. respectively above the outside temperature can be maintained.

To insure against dust particles settling on the newly manufactured rayon every duct outlet is covered with a fine-mesh screen. This screen also serves to distribute the fresh air. The air is drawn through a large exhaust opening at the rear of the room, over heating stacks and delivered by a 35,000-cu.ft. per min. fan to an adjoining spinning room. The fan and heating units are employed only in cold weather.

Spinning of the rayon fiber takes place in an acid coagulating bath. As the fiber is formed hydrogen sulphide is set free and if allowed to escape into the room would cause harmful effects to the workmen. Accordingly, all of the spinning machines are provided with ducts through which fumes are exhausted by three fans having a capacity of 224,000 cu.ft. per min. These fans deliver the fume-laden air to a brick stack which discharges the fumes into the atmosphere at a sufficient height to render them practically unnoticeable due to tremendous dilution with the outside air.

In the bleaching room heated outside air is brought in near the ceiling and the exhaust outlets are under the hood over the bleaching equipment. The outlets remove the fumes and prevent condensation on the ceiling of the room. The exhausts are made of galvanized copper-bearing iron covered with a bituminous paint.

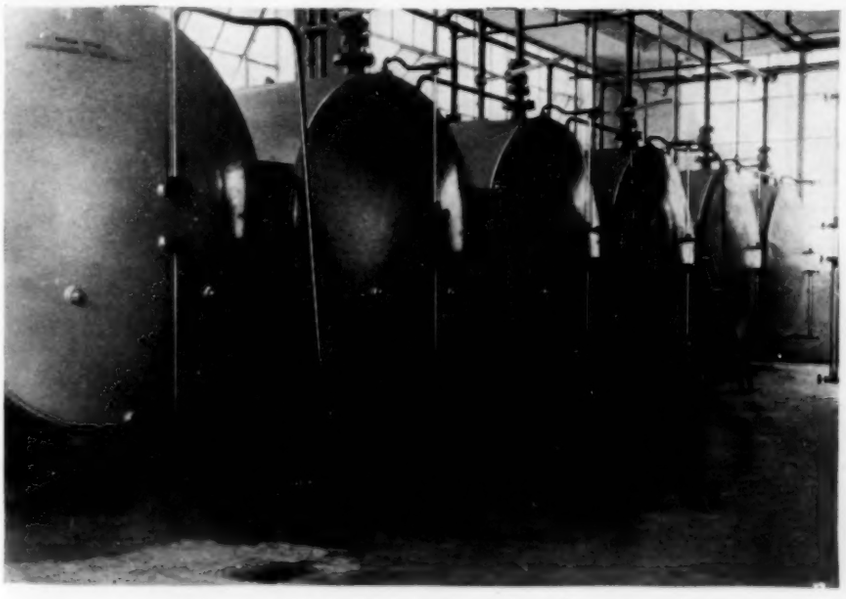
After bleaching the yarn is passed through Proctor & Schwartz dryers. It recovers the normal moisture content and is cooled to room temperature in the moisture regain chamber at the end of the dryer.

Rayon is inspected and skeined in the finishing room. Here air conditioning serves two purposes; it maintains the moisture content of the product at a maximum of 10 per cent, and it prevents perspiration of the workers' hands, which would soil or otherwise damage the thread during the inspection.

Conditioning in the finishing room is accomplished by means of a motor-driven low-pressure centrifugal-type refrigeration unit. This machine cools the water used in the air-washing equipment. In the warm months of the year water in the air washer cools the supply air sufficiently to maintain a relative humidity of 60 per cent in the room, and in the cold months heating stacks, at the fan and at the fresh-air inlet, heat the air supply, maintaining the same relative humidity. In the winter it is often necessary to heat the water for the air washer in order to obtain the desired conditions. To do this a mixing fitting has been provided whereby steam at 20 lb. pressure may be used to heat the water. This mixing fitting has also been installed at the other air washers.

Shipping and storage rooms are also conditioned. In the former the ventilating system is also used for heating the room. The fin-type heating coils and fans are suspended from the ceiling. In summing up it might be said that in the viscose process of manufacturing rayon, air conditioning is essential throughout much of the process. It is required while the soda-cellulose and viscose solution are aged and from the time the fiber is spun until it is shipped.

Before closing the author wishes to acknowledge the generous cooperation of H. B. Kline, vice-president in charge of manufacturing, of the Industrial Rayon Corp.

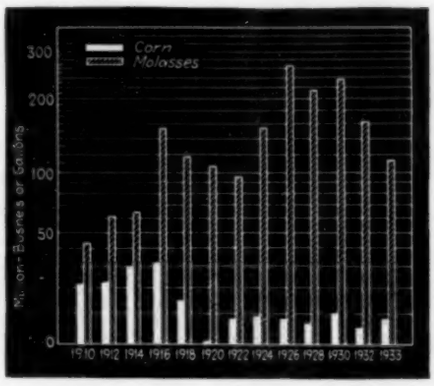


Caustic soda is pumped to the dissolving and mixing tanks located on the top floor of the chemical building where the two solutions of different concentrations are prepared. From this point they are distributed by gravity to the stations where they are used

Design of a MODERN MOLASSES DISTILLERY

By GUSTAVE T. REICH
Pennsylvania Sugar Co., Philadelphia, Pa.

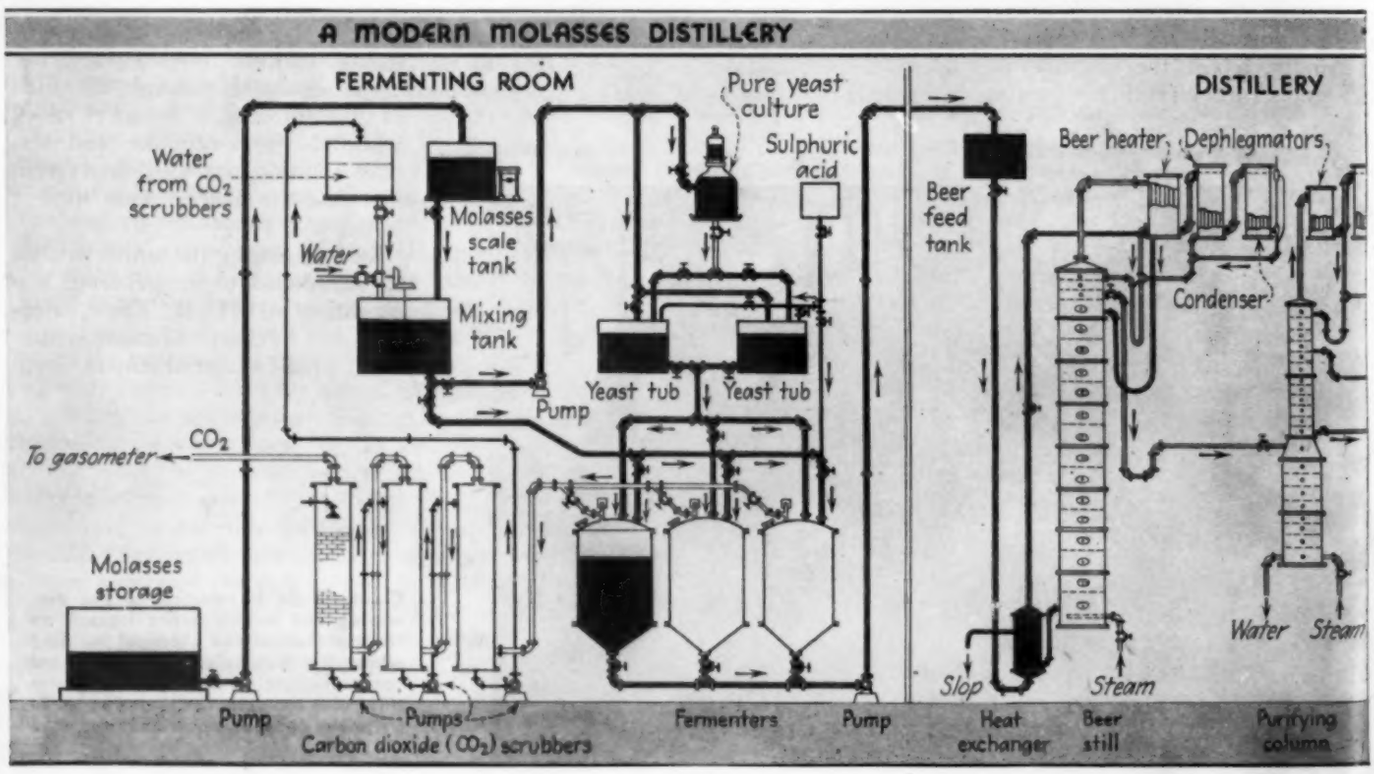
EDITOR'S NOTE: This is the second of two articles by Dr. Reich discussing the manufacture of alcohol and distilled spirits. "Distilling Beverages From Grain" appeared in the December, 1933, issue.



Raw materials used in alcohol manufacture, 1910-1933

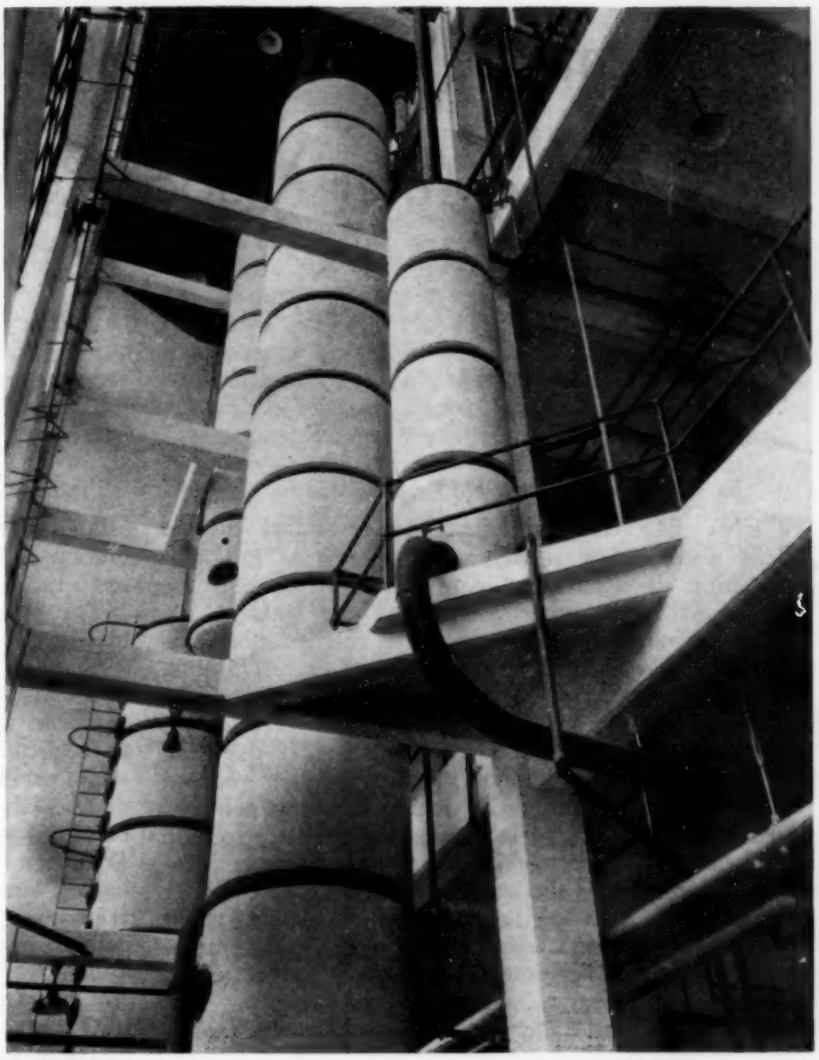
ANTICIPATING the great revival of the grain alcohol industry the general public impression is that the molasses alcohol industry will suffer greatly, which, in fact, is not the case. The quantity of molasses used for the production of alcohol amounted in 1915 to approximately 123,000,000 gal. and in 1932 to over 161,000,000 gal. During the last 18 years considerable strides have been made in the use of alcohol in the lacquer industry and as anti-freeze; furthermore, the manufacturers are constantly developing new products and new uses for their alcohol. As the cost of manufacturing grain alcohol is greater than that of molasses alcohol, owing to the higher cost of raw material and manufacture, grain alcohol will not be able to supplant molasses alcohol in non-beverage industrial applications.

In 1932 about 64,500,000 gal. of alcohol was produced from molasses (calculation based on 2.5 gal. molasses per gal. of 190 deg. alcohol). Its manufacture is much simpler than that from grain. The milling, cooking, malting is omitted, consequently the capital investment and operating expenses are much less. As to the cost of molasses, it has varied in recent years between 3 to 12c. per gallon and at present it is sold around 4 to 6c. per gallon.



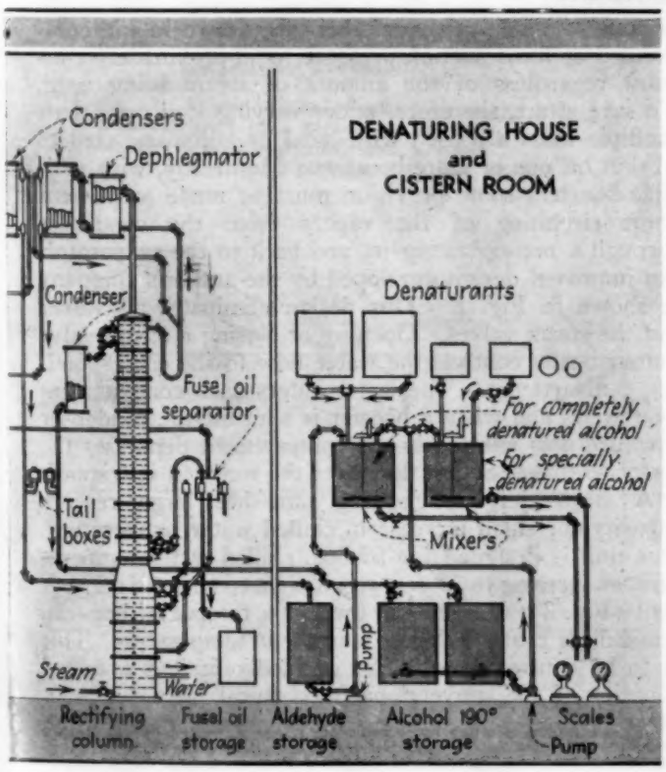
America's most recent and modern molasses alcohol distillery

Continuous still producing 8,000 gal. per day of 95 per cent alcohol. Designed and installed by the Lummus Co. in the new plant of the New England Alcohol Co., Everett, Mass.



The manufacture of alcohol from molasses consists of the following steps: (1) Weighing of the molasses. (2) Mixing with water. (3) Sterilizing (in some plants). (4) Cooling or diluting with cold water. (5) Preparation of the pure culture yeast. (6) Charging the fermenters with the dilute molasses. (7) Addition of pure culture yeast and sulphuric acid and yeast food. (8) Fermentation. (9) Distillation.

The molasses which is received by steamers from Java, Cuba, Hawaiian and Philippine Islands, and Porto Rico is stored in large steel storage tanks each holding several million gallons. From these storage tanks molasses is delivered to the weighing tank in order that all the molasses entering the process may be accurately weighed. It is then pumped into mixers where four parts of water are added to one part of molasses. The diluted molasses, called "mash," has a density of approximately 18 deg. to 22 deg. Brix. To judge an ultimate yield from the density is misleading, as quite frequently a high density molasses may have a low fermentable sugar content. It is then pumped into the fermenters and approximately ½ to 1 gal. of sulphuric acid, and about 1 lb. of ammonium sulphate per 1,000 gal. of wort is added. The acid inverts the sucrose into glucose and levulose as shown previously in the article on grain fermentation, while the ammonia salt acts as a yeast food, molasses being deficient in nitrogenous products.



After the molasses, water and chemicals are thoroughly mixed approximately 5 per cent of its volume of ripened yeast is added. The fermentation of the molasses is quite rapid and is completed within 36 to 48 hr. When the fermentation ceases, the density of the beer is 4 deg. to 6 deg. Brix and its temperature between 95 deg. to 105 deg. F. In some distilleries the fermenters are provided with cooling coils, thereby maintaining a temperature around 85 deg. to 90 deg. F. The alcohol content of the fermented mash "beer" is from 6.5 to 8.5 per cent by volume. It is pumped into the beer rectifying still as shown in the accompanying illustration, and de-alcoholized by a single continuous distilling operation producing 95 per cent alcohol. The slop is recovered only in localities where the health authorities prohibit the pollution of the rivers.

Steam Jet and Centrifugal Water Vapor Refrigeration

By PAUL BANCEL
Manager, Condenser Dept.
Ingersoll-Rand Co.
New York, N. Y.

TEXT BOOKS and handbooks invariably dispose of water vapor refrigeration systems as impractical, citing the extremely high vacuums that must be maintained against the handicap of air leakage, the enormous volume of vapor per unit of refrigeration compared to other systems and the implied excessive bulk, cost and complication. These difficulties arise from the fact that water is a decidedly non-volatile refrigerant; at mean atmospheric pressure it boils at 212 deg. and even at very high altitudes its boiling point is reduced only to about 160 deg. To reach a boiling point of 50 deg., it is necessary to reduce the pressure to 0.36 in. of mercury or a vacuum close to the barometer. Under these conditions the specific volume of water vapor is over 1,700 cu. ft. per lb. and a displacement of about 350 cu. ft. a minute is required per ton of refrigerating effect (200 B.t.u. a minute).

The development of water vapor refrigeration has therefore depended in turn on the development of compressing units capable of sweeping very large volumes of low density vapor. These have taken two forms: the steam jet booster and the centrifugal compressor.

Steam Jet Refrigeration

The use of steam ejectors for compressing water vapor was suggested by Sir Charles Parsons about 30 years ago. Commercial development of Parsons' idea was probably delayed by the inefficiency of the boosters available; even as recently as 5 years ago steam consumption was relatively high and the back pressure attainable decidedly low, compared to present day good design.

Steam jet refrigeration consists of apparatus in which the water vapor boiled off at low pressure is compressed by ejector action of a steam jet and discharged at a pressure high enough to permit condensation by water of ordinary temperature. With either natural or artificial supplies of cooling water, it is possible to condense the steam at around 28 in. vacuum or 2 in. of mercury absolute pressure.

In addition to the steam jet booster, the apparatus consists essentially of an evaporator and a condenser with auxiliary air pump. The water to be cooled is sprayed into the evaporator. If the water enters at 55 deg. and the absolute pressure within the evaporator is maintained at 0.36 in. of mercury, which corresponds to a boiling point of 50 deg., then it is obvious that evaporation must take place until the water is cooled to a temperature of 50 deg.

The popularity of steam jet refrigeration rests primarily on the advantage of direct evaporation without a chemical, on simplicity, low up-keep cost, and absence of moving parts. However, where steam and water are available at ordinary costs, the economy of operation is frequently an important advantage. In general, with steam pressures of 100 lb. or more a steam consumption of 25-30 lb. per ton may be assumed, and the hourly cost of steam will be of the order of 0.75-3 cents per ton. With low pressure steam, steam consumption will be higher, but the steam less expensive. A mechanical refrigeration unit may be assumed to require about 1 hp. per ton, and if motor driven, a power input of less than a kilowatt. Depending on the cost of power, the hourly cost may again be anywhere from a fraction of a cent to 3 cents per ton.

The capacity of a given booster ejector, that is the pounds of water vapor or other gas, drawn in and compressed at fixed suction pressure, is approximately constant regardless of the amount of steam being used. To save steam, therefore, under varying load conditions multiple units are used with hand or automatic control to shut off one or more boosters. Manifestly, with multiple boosters some provision must be made to prevent short circuiting of the vapors from the condenser through a non-operating jet and back to the evaporator. An improved design developed by the author's company is shown in Fig. 1. This design eliminates all valves but the steam valves. Opening or closing a steam valve automatically controls the water flow to the corresponding compartment. The water enters each compartment over weirs and when a booster is shut off the condenser pressure now exerted in the compartment depresses the water so that it cannot flow over the weir but is trapped.

A steam jet refrigerating unit has large reserve capacity for small increase in chilled water temperature. If a unit is designed for 50 deg. chilled water temperature, an increase to 55 deg. results in a tonnage of 120 per cent (Fig. 2). In general, there is a reserve of between 4 and 5 per cent per degree increase in temperature. This is to be contrasted with the decidedly limited overload capacity of the conventional mechanical plant.

Condensed from a much more complete paper presented by the author under the title of "Water Vapor Refrigeration," before the Roanoke meeting of the American Institute of Chemical Engineers, Dec. 13, 1933.

However, a refrigerating plant must not only cope with heavy tonnage demands but also excessive head or back pressures due to extremely hot condenser water. At such times a mechanical unit requires excess power and falls off in tonnage produced, or for full tonnage produces higher chilled water temperatures. Under similar conditions of excess back pressure a steam jet unit may fail to function entirely. This characteristic is inherent in the nature of compression by kinetic action.

If the condenser is designed for 85 deg. water and 2 in. back pressure an increase to 90 deg. would reduce the vacuum, or increase the back pressure to 2.3 in. With 0.36 in. evaporator pressure the ratio of compression demanded of the booster is thus increased from 5.5 to 6.35, which is beyond a commercial leeway of design. The booster will therefore break back until the evaporation pressure has increased by a relatively large amount and the chilled water temperature is 10 or 20 deg. hotter.

Reserve against instability or failure of this type lies in an increase of steam pressure. As shown in Fig. 3 every increment in steam pressure results in a corresponding increase in back pressure against which the booster jet continues efficient operation. The unit therefore has a very desirable characteristic of increased tonnage capacity under conditions of extremely hot condensing water and high back pressure which are most likely to coincide with heavy tonnage demands.

Centrifugal Refrigeration

In the centrifugal water-vapor unit a centrifugal compressor of large capacity takes the place of the steam jet boosters. The heat discharged to the condenser is therefore only the refrigeration load, plus the work of the compressor as with the ordinary refrigerating cycle. However, design of a suitable unit was very complex, due to the enormous volume of vapor to be handled. Extensive experiments were conducted by the Ingersoll-Rand Co. It was demonstrated that the cycle was entirely practical and the anticipated reactions to load variations proved. An experimental machine was followed by a commercial machine illustrated in Fig. 4. The compressor is set upon a base which also forms the evaporator and the condenser is attached to the compressor discharge, thus producing a compact simple assembly. Standard sizes ranging from 50 to 300 tons are available. Instead of the motor with speed-up gear a direct drive turbine can be used. Speeds are from approximately 7,000 to 10,000 r.p.m., depending on size.

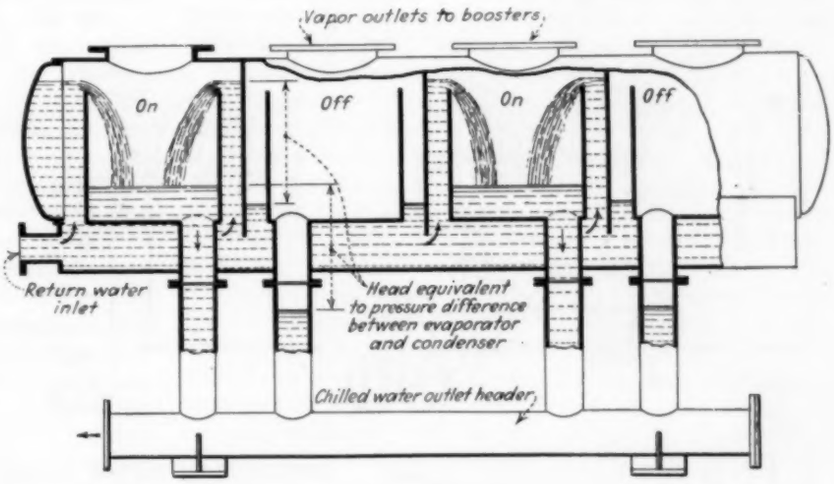
The brake horsepower requirements of refrigerating units involve many factors of design and proportion; of these the efficiency of the compressor itself is probably

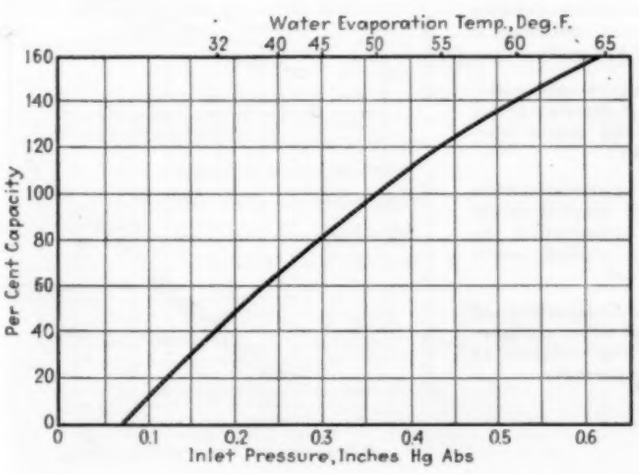
STEAM JET REFRIGERATION

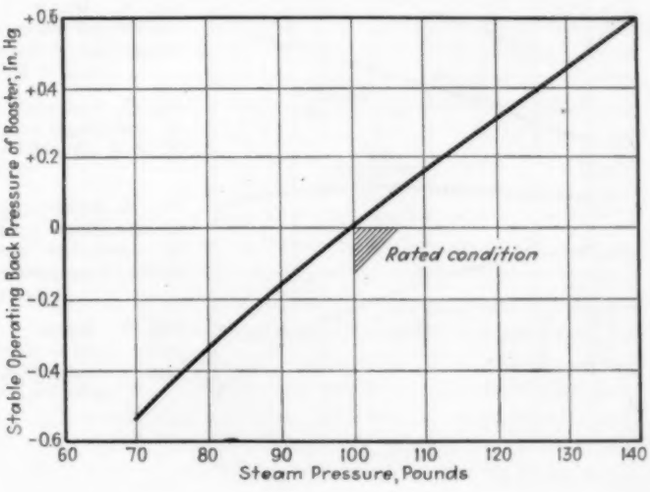
Fig. 1, Right—Ingersoll-Rand evaporator for multiple boosters, water flow in which is automatically controlled by operation of boosters

Fig. 2, Below—Capacity characteristics of a steam jet booster: large reserve capacity for small increase in chilled water temperature is shown

Fig. 3, Lower Right—Back pressure characteristics of a steam jet booster: reserve against instability lies in steam pressure increase







most important, and there can be no question of the fact that a centrifugal compressor is usually less efficient than a reciprocating machine. However, because of lower theoretical requirements for the water cycle, the brake horsepower of the centrifugal unit may be said to compare favorably with any type of refrigeration, frequently being less.

This unit differs fundamentally from all other types in its part load characteristics. Under the usual operation at constant speed and without any other adjustments, reduced tonnage is automatically reflected in reduced power, approximately in proportion to the tonnage. The unit simply floats on the load.

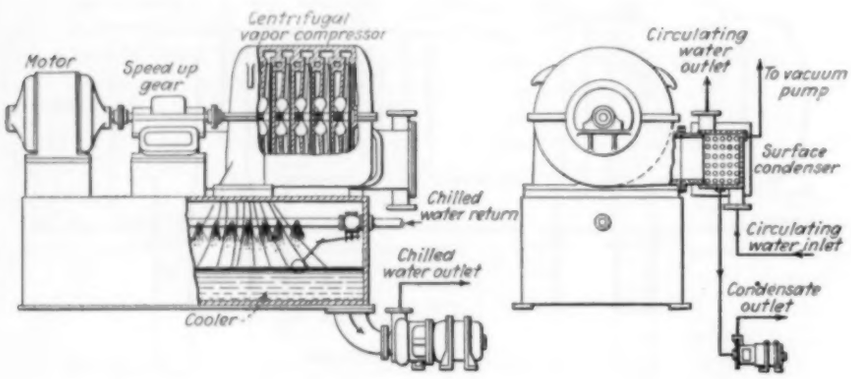
In Fig. 5 is shown a typical volume characteristic of a centrifugal compressor: as the volume decreases the ratio of compression increases, and over the designed range there is a flat efficiency curve. At part volumes the brake horsepower decreases but not proportionately. Within limits, a decrease in density at fixed volume results in an equivalent reduction in power. With decreasing load, a change occurs in both volume and density, so that, in effect, there is first, a decrease in volume proportionate to the decrease in load, as from *A* to *B*. Then, a decrease in density and increase in specific volume which now increases the total volume to intermediate value *C*.

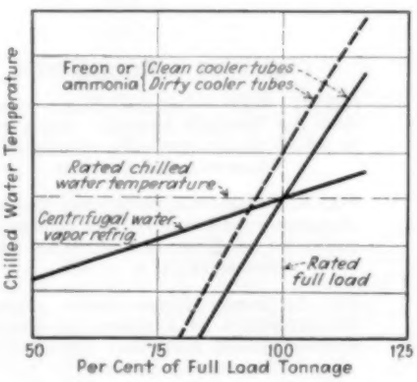
The characteristics of a unit at varying condenser water temperature, plotted against tonnage, are shown in Fig. 6. Condensing water quantity is maintained constant for all three curves of each group; in each group the center line corresponds to rated maximum condensing water temperature. Horsepower and chilled water temperature are seen to be approximately parallel straight-line functions of the tonnage.

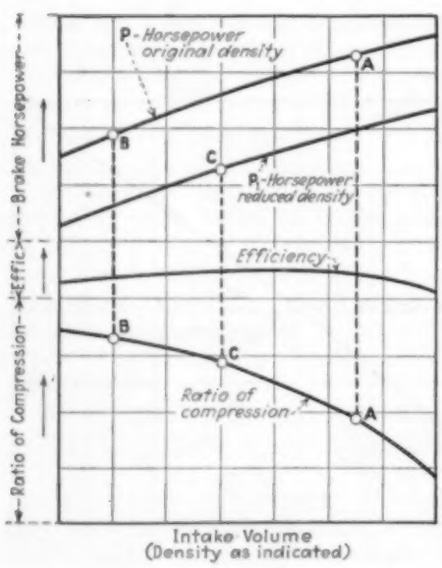
It was shown in connection with the steam jet unit that only a small increase in chilled water temperature occurs at overloads. A similar characteristic is true of the centrifugal machine. For a moderate overload the increased chilled water temperature is very slight.

This is to be contrasted with the very sharp increase in chilled water temperature in the case of machines using a refrigerant. In the latter the effect of scaling of the heat transfer surfaces is also an important cause of reduced efficiency. Fig. 7 shows the comparison of the characteristics of the conventional refrigerating machine with the centrifugal water vapor type.

Standard steam jet or centrifugal machines are not designed for cooling brine or for producing freezing temperatures. Temperatures from 35 deg. up can usually be obtained but in general low temperatures should not be specified except for part load. A chilled water temperature around 50 deg. is the normal rating of water vapor units. Maximum condensing water temperature should be definitely anticipated and specified; this is particularly true with cooling towers and ponds which in the author's experience tend to be rated on more favorable wet bulb temperatures than may actually prevail for appreciable periods of time.







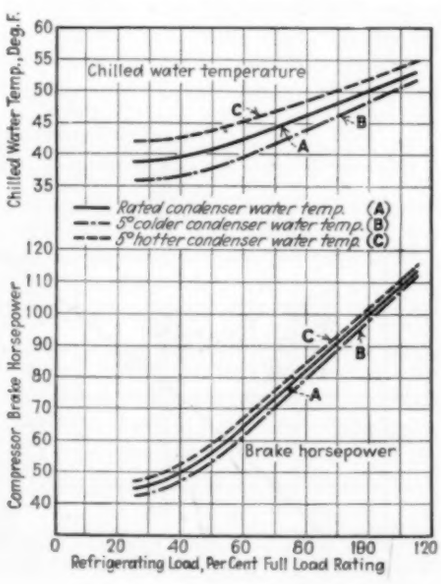
CENTRIFUGAL WATER VAPOR REFRIGERATION

Fig. 4, Upper Left — Ingersoll-Rand centrifugal water vapor system showing compressor, evaporator and condenser as used in 50-300 ton units

Fig. 5, Left—Operating characteristics of centrifugal vapor unit showing effect of load on efficiency and power consumption

Fig. 6, Right—Operating characteristics of centrifugal vapor unit showing effect of condenser water temperature on brake horsepower and chilled water temperature

Fig. 7, Upper Right—Comparison of water cycle with that of other refrigerants showing effect of load variation on chilled water temperature


Chilled water temperature
Chilled Water Temp., Deg. F.
Rated condenser water temp. (A)
5° colder condenser water temp. (B)
5° hotter condenser water temp. (C)
Compressor Brake Horsepower
Brake horsepower
Refrigerating Load, Per Cent Full Load Rating

Economic Considerations Govern Equipment Replacement

By WYMAN P. FISKE

Assistant Professor of Accounting
Massachusetts Institute of Technology
Cambridge, Mass.

MUCH LITERATURE is available on the economics of replacements. Investigations made by various individuals have resulted in the publication of a number of formulas designed to assist the business man in reaching a sound decision. These formulas are of varying complexity and soundness. Many of the analyses offered by equipment manufacturers are hopelessly inadequate. Business men, and particularly those concerned with plant, naturally approach the question of plant replacement in a state of bewilderment as to which of the many formulas and analyses they can accept as satisfactory. It is not the object of this paper to add to the present confusion by suggesting a new formula. Rather it is the object to point the way to such fundamentals as will simplify what has been made unduly complex.

Perhaps the most common error in comparing equipment or processes is to fail to make the comparison on similar tasks. The assumption is frequently made, often unconsciously, that the total output of two machines of varying capacities can be used. This is certain to lead to unfortunate results. Comparison should always be made upon the basis of the production required, and that production must be identical for the two alternative methods under consideration. This assumption will usually mean either considerable unused capacity under one method or else two or more units under the other method. Savings in running time per unit of operation do not result in savings in cost unless the added production possible can be used or unless operators can be shifted to other tasks (or laid off). In every case, total annual costs must be charged to the production of the period; if the machine is idle half the time, then the busy half must bear the total costs.

The mistake described in the previous paragraph is always made easier by attempts to make the comparison on the basis of unit costs. Conversely the use of annual costs of required production will avoid this and other errors. There is no fundamental error in the use of unit costs, but the reasoning is difficult, and the adjustments more delicate.

A real error, and a common one, lies in the assumption that certain expenses will be the same under both methods. The trouble is that expenses which we assume to be common have an unfortunate habit of differing. Labor costs obviously differ, material cost may differ, and burden also will vary in most cases. Every item of expense must be considered in detail to determine the effect of the new equipment or method.

The word "saving" is subject to misinterpretation. The popular confusion between saving and reduction of cash outlay should not bother trained engineers. A saving exists when there is an increase in net worth resulting from the adoption of the new method. Unless net worth (the owner's interest in the business) increases, apparently favorable changes in cash or any other asset or liability are not accompanied by real savings. Any analytical comparison of two machines, methods or processes must, therefore, seek to measure the effect of various choices on profits and net worth.

The substitution of a new machine or method for an existing one must depend on the relation of resulting savings to the added investment required, rather than to either the total cost of new equipment or that plus the loss on the old. If the savings constitute an adequate return on the added investment, the purchase is desirable and the mere fact that this saving does not constitute an adequate return on the total cost or the total cost plus the loss on the old equipment is no reason for not making the purchase. The investment in old equipment is a sunk cost to which the enterprise is committed. New equipment should not be burdened with a requirement of earning a return on past mistakes. If the old equipment can be used for partial payment on the new either by sale or exchange, then the amount of investment necessary to accomplish the desired saving is correspondingly reduced and the change becomes increasingly attractive. Where the comparison is between present hand methods and a choice of new methods involving the purchase of equipment, the saving accomplished by the least expensive equipment must of course be related to the entire cost of that equipment; the additional saving resulting from more expensive equipment must be measured against the additional investment required.

Most of us are familiar with comparative balance sheets and income statements. The same simple arrangement can be used in the comparison of equipment. Table I illustrates an arrangement that might be used. The object of this tabulation is to guard against the errors that often arise in the use of the formulas previously mentioned. It therefore begins with a statement of the estimated required average annual output in units. Expenses are itemized and entered as estimated average

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Based on a paper presented by the author under the title of "Amortization, Depreciation, Obsolescence and Replacement," before the Roanoke meeting of the A.I.Ch.E., Dec. 12, 1933. An earlier paper from this source, appearing on pp. 26-29 of the January, 1934, issue of *Chem. & Met.*, covered the first three subjects of the author's title.

annual expenses. The final figure is the rate of savings to the additional investment required. Real difficulty will exist in estimating average production and the expenses involved in that production. Many of the expenses will, of course, be fixed regardless of the rate of production, but others will vary. The tendency of repairs to increase as time passes must be taken into consideration.

Many business men purchase equipment only when it will pay for itself within a definite and usually short period. The determination of the period within which equipment will pay for itself is of interest to such individuals. The problem is simple as soon as it is realized that the period is the number of years it will take the net savings, before including provision for depreciation on the new equipment, to amount to the investment required. A simple modification of the "Comparison of Equipment" will provide the answer. This is shown as Table II. Interest is included because the savings should provide an interest return on the investment in addition to return of the investment. Interest is computed on a base of one-half of the present cash value of each equipment since that is the average investment during the use of the equipment.

An important element of expense and therefore of savings is depreciation. Adequate treatment of this item is essential to a sound comparison of methods or machines. In the tabulation shown as Table I, depreciation has been included but is based on the present cash value of each equipment. The equipment, the replacement of which is under consideration, will be carried among the plant items at a book value determined by deducting accrued depreciation applicable to this equipment from its original cost. Only by chance will this book value coincide with the second-hand or cash value of such equipment.

Much discussion and many mistakes have centered about the choice of base upon which the depreciation figure used in the comparative analysis is to be computed. The use of both book and present cash values has been advocated and the use of either will lead to sound conclusions provided there is a proper accompanying treatment of other items. The use of present cash values as the depreciation base for both the old and the new equipment was chosen for reasons presently to be outlined. Of course for the new equipment the present cash value, the installed cost and the book value are identical. For the old, however, the book and present cash values will differ for the reason that depreciation rates are determined to write the original cost down to the second-hand or scrap value at the estimated time of retirement; retirement at any time in advance of that date is proof that the original estimate of serviceable life was in error and will usually find the book value in excess of the then cash value. Consequently disposal of the equipment will involve a write-down because of unexpected obsolescence. The treatment of this write-down in the comparison has caused the difficulties. Obviously the cost reductions (including the annual depreciation charge) resulting from the new equipment must be large enough to offset this necessary write-down, for it is the size of the savings which renders the old machine obsolete and decreases its value more rapidly than would have been the case had the new equipment not been developed. Provision for absorption of the write-down will be accomplished by the use of a depreciation figure which is based on the cash value of the old equipment at the time of substitution, while the use of a depreciation figure which has been based on book value will fail to make such provision. (See illustrative example in Table III.)

Recent industrial and economic developments have forced reconsideration of equipment policies. Basic to an intelligent approach to such policies is an understanding of the effect of equipment upon costs. All expenditures for equipment must be recognized as prepaid expenses representing services to be performed in the obtaining of future product. Accordingly, provision must be made for including a proper portion of such outlays in determining the costs of product benefiting. Amortization, depletion and depreciation are all expense items having for their object the making of such provision; they differ only in the type of assets to which they apply; amortization applying to intangible prepaid items such as insurance; depletion to wasting natural assets; and depreciation to buildings, machinery and equipment. Like other expenses they serve to keep in the business assets acquired in sales transactions equiv-

Table I—Arrangement for Comparing Savings Possibilities of New Vs. Old Equipment

		Old Equipment	New Equipment
(1)	Estimated required average annual output* (in units)		
	Estimated average annual expenses		
	A. Machine Cost		
(2)	Depreciation**	$	$
(3)	Taxes		
(4)	Insurance		
(5)	Maintenance and repairs		
(6)	Power		
(7)	Space cost (rental charge)		
(8)	Supplies		
(9)	**B. Direct Labor Cost**		
(10)	**C. Material Cost**		
	D. Other Costs (itemize)		
(11)	Special tools		
(12)	Indirect labor		
(13)			
(14)	Total Expenses	$	$
	Net Savings		
(15)	New over old		
(16)	Old over new (in red)		
(17)	Total installed cost new equipment		
(18)	*Less:* Allowance on old equipment		
(19)	Additional Investment		
(20)	Per Cent Net Savings to Added Investment (15) (19)		%

*Must be identical for both equipments
**Based in each case on *present cash value* and estimated probable useful life

Table II—Determination of Period During Which New Equipment Will Pay for Itself

		Old Equipment	New Equipment
(1)	Estimated required average annual output* (in units)		
	Estimated average annual expenses		
	A. Machine Cost		
(2)	Depreciation**	$	
(3)	Taxes		$
(4)	Insurance		
(5)	Maintenance and repairs		
(6)	Power		
(7)	Space cost (rental charge)		
(8)	Supplies		
(9)	**B. Direct Labor Cost**		
(10)	**C. Material Cost**		
	D. Other Costs (itemize)		
(11)	Special tools		
(12)	Indirect labor		
(13)			
(14)	Total Expenses (exclusive of depreciation on new equipment)	$	$
(15)	Interest @ 6% (on one-half present cash value of each equipment)		
(16)	Net Savings (Providing for interest on average investment but omitting depreciation on new equipment)		
(17)	Total installed cost new equipment		
(19)	Number of years required for new equipment to pay for itself out of savings		yrs

*Must be identical for both equipments
**Based on *present cash value* and estimated probable useful life

alent to assets consumed in operations. While many advocate the segregation in a special replacement fund of assets retained by charging depreciation, this should be recognized as a question of financial policy. Such segregation not only is usually unnecessary but also actually results in withdrawing assets permanently from earning power. In the replacement of equipment careful analysis is needed to determine the reality of supposed savings claimed by machinery salesmen. The use of complicated formulas is unnecessary, however, for simple tabulation plus the exercise of intelligence will assure sound results.

Table III—Case Illustrating Effect of Substitution of Equipment

A. Assumptions

I. Condensed balance sheet at time of proposed substitution

Current assets	$150,000	Current liabilities	$ 50,000
Plant	100,000	Net worth	200,000
	$250,000		$250,000

II. Data on present plant

Book value	$100,000
Cash value	$ 25,000
Estimated life	5 years
Final scrap value	none
Total annual operating expenses exclusive of depreciation	$100,000

III. Date on proposed equipment

Installed cost	$150,000
Estimated life	10 years
Final scrap value	none
Total annual operating expenses exclusive of depreciation	$ 90,000

IV. Gross annual income, $120,000

B. Analysis of savings

I. Basing depreciation of old equipment on *cash value*

Expenses	Old	New
Depreciation	$5,000	$15,000
Other operating expenses	100,000	90,000
	$105,000	$105,000
Net saving	no gain	nor loss

II. Basing depreciation of old equipment on *book value*

Expenses	Old	New
Depreciation	$20,000	$15,000
Other operating expenses	100,000	90,000
	$120,000	$105,000
Net saving—new over old		$15,000
Total installed cost of new equipment		$150,000
Less: Allowance on old equipment		25,000
Additional investment		$125,000
Per cent net saving to additional investment		12½

C. Comparison of effects of retention and substitution on balance sheet

I. Effect of retention for five years

	Beginning Balance Sheet		Debit		Credit		Final Balance Sheet	
Current assets	$150,000		(b) $600,000		(d) $500,000		$250,000	
Plant	100,000				(a) 75,000			
					(c) 25,000			
Current liabilities		$50,000						$50,000
Net worth		200,000	(a) 75,000		(b) 600,000			200,000
			(c) 25,000					
			(d) 500,000					
	$250,000	$250,000					$250,000	$250,000

(a) Write down of old machine
(b) Gross income (5 years @ $120,000)
(c) Depreciation (5 years @ $5,000)
(d) Other expenses (5 years @ $100,000)

II. Effect of substitution over five year period

	Beginning Balance Sheet		Debit		Credit		Final Balance Sheet	
Current assets	$150,000		(a) $25,000		(b) $150,000		$175,000	
			(c) 600,000		(e) 450,000			
Plant	100,000		(b) 150,000		(d) 75,000		75,000	
					(a) 100,000			
Current liabilities		$50,000						$50,000
Net worth		200,000	(a) 75,000		(c) 600,000			200,000
			(d) 75,000					
			(e) 450,000					
	$250,000	$250,000					$250,000	$250,000

(a) Sale of old machine
(b) Purchase of new machine
(c) Gross income (5 years @ $120,000)
(d) Depreciation (5 years @ $15,000)
(e) Other expenses (5 years @ $90,000)

III. Effect of retention for various periods

Balance Sheets* at the End of Various Periods

	1 Year	3 Years	5 Years	10 Years
Current assets	$170,000	$210,000	$250,000	Old equipment retired at end of five years and must be replaced by similar or other machine.
Plant	20,000	10,000		
Total assets	$190,000	$220,000	$250,000	
Current liabilities	$50,000	$50,000	$50,000	
Net worth	140,000	170,000	200,000	
Total liabilities	$190,000	$220,000	$250,000	

*Determined as in sections CI and CII

IV. Effect of substitution for various periods

Balance Sheets* at the End of Various Periods

	1 Year	3 Years	5 Years	10 Years
Current assets	$55,000	$115,000	$175,000	$325,000
Plant	135,000	105,000	75,000	
Total assets	$190,000	$220,000	$250,000	$325,000
Current liabilities	$50,000	$50,000	$50,000	$50,000
Net worth	140,000	170,000	200,000	275,000
Total liabilities	$190,000	$220,000	$250,000	$325,000

*Determined as in sections CI and CII

Comment on Effects of Retention and Substitution

The results of the analyses in BI and BII above were that in the analysis in which depreciation was figured on the basis of cash value there was no saving (nor any loss) resulting from the substitution of the new equipment; it was therefore a matter of financial indifference whether the old machine was retained or the new one substituted. The other analysis, in which book value was the basis, showed an apparent saving. Consideration of the effects of retention and substitution on the balance sheet (CI, CII, CIII and CIV above) shows the net worth item to be identical under either hypothesis at the end of any period.* This equality of the net worth item shows clearly the fact of neither loss nor gain, and supports the use of cash value as a basis for computing depreciation on the old equipment as far as the comparison is concerned. At the same time, however, the net worth in each case increases from year to year by a constant amount, $15,000. Total costs (including both depreciation and other operating expenses) appears as $105,000 for both machines under analysis BI, while the assumed gross income is $120,000; hence an annual income of $15,000 will appear on the operating statement if the new machine is substituted, or if the old machine is written down to cash value (which it would not be).

Total expenses for the old machine in BII (where book value was used) were $120,000, so that the operating statement would show no profits; but the same profit of $15,000 appears for the new machine and is shown in the analysis as a net saving. Careful consideration will show the $15,000 item to be a legitimate profit on the annual operating statement, but not to be a saving. This is true because if the old machine is discarded the loss due to write-down must be taken at a cost of prior production, while annual operating costs (including depreciation) will be reduced by the substitution; if the gross income remains the same there will be a profit on the operating statement. Until sufficient time has passed, however, for the annual profits to equal the write-down there is no saving in the sense of improved net worth, for while the write-down must be taken immediately as a cost of past production if the old machine is discarded, the whole book value (assuming no ultimate scrap value) will be treated as a cost of future production if it is retained. The use of cash value as a basis for depreciation in the analysis decreases the annual costs of the old machine by an amount equal to a proration of the difference between book and cash values of the old machine over its remaining life. It thus requires the costs under the substitute plan to be decreased by the same amount before any saving appears.

*Net worth is identical at all times from the start only if the write-down to cash value is taken immediately in both cases. Otherwise, the net worth under the assumption of retention will remain constant at $200,000 while five years (the remaining life of the old equipment) must pass before the net worth under the assumption of substitution reaches $200,000. The reason for this will appear in the text above. Of course if the old equipment is kept, the write-down will not be made; regular depreciation will continue.

Use of natural gas for fuel and absence of waste factory products makes possible situation of A. R. Maas Chemical Co. in a semi-residential district

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Adapting Products To Local Markets

WE TECHNICIANS have in the past devoted our energies so effectively to improvements of the chemical processes that the economic considerations have been somewhat neglected. In this account the emphasis is transferred from technical improvements to adaptation to environment. There is more than accident in the fact that a factory is called a "plant." Like a botanical plant a chemical plant lives and grows from youth to age and dies. Both suffer the fiercest competition and if either is ill adapted to local conditions it is quickly crowded out.

The A. R. Maas Chemical Co. is situated in a region of marked economic instability. Change is bewilderingly rapid. Districts change so much in five years as to be hardly recognizable. New businesses rise like mushrooms and, alas, are sometimes as evanescent. If a plant builds for the present only, in five years it is obsolete. If, on the other hand, it is designed for the estimated capacity of five years ahead, it may run in the red because of over-capacity. The effect of these conditions is to put a premium on low investment and temporary construction, even though operating expenses are thereby increased. Few California concerns appreciate this and premature large expenditures for plant are regrettably common. Those firms are fortunate that have to restrict their capital outlay.

The development of the A. R. Maas Chemical Co., of Los Angeles, in ten years from a bath tub to a seven-acre site, with two acres of buildings and connections with two railroads, is interesting because so many conventions of Eastern chemical engineering practice have been disobeyed successfully. The company, after a few years of "finding its feet" and making its mistakes on a small scale, has evolved a policy of adaptation to local conditions which is working well.

Instead of the usually sound practice of locating a plant where conditions are best for manufacture of the proposed product, the firm has followed the different and sometimes dangerous policy of locating near a large potential market and then seeking products that could be manufactured and sold in that district to advantage. Nearness to the consumer was judged to be more important than the advantages due to large capacity or cheap raw materials.

It is the duty of their research department to study continually the possibilities of making new products at a profit. Not one in ten of the projects examined is found to have promise, and the fault is usually that a market survey shows local demand to be too small to justify manufacture. If a probable local sale of $10,000 per annum is indicated, a detailed study of the project is made. According to Eastern standards such a prospective volume would be too small, but in this new and rapidly growing section it pays to be the first to claim a market, which may increase in a few years to respectable dimensions. Usually no other competitor enters such a small chemical field, in which it is obvious that two cannot survive.

An unusual feature of office organization that might not work as well elsewhere in that cost accounting is done by the research department. Little attention is paid to past performance, but in these distracting times there is a frequent demand for next month's costs and for estimates of the effect on factory operation of gaining or losing a contract.

It has been found that training its own staff is not good policy for a small concern, as there are no minor positions in which a novice can gain his experience. The men of the Maas staff have all received their training with other successful chemical companies, chiefly the larger Eastern concerns. Technically trained men constitute 25 per cent of the total employees.

The high wage cost made necessary by the employment of so many technical men is balanced and made possible by a low capital cost. Williamson (Chemical Engineering Economics, 1926) states that the average capital investment of the chemical industry is $1.30 per dollar of annual sales. The Maas company's investment, including working capital, is 53c. per dollar of annual sales.

Two causes for this departure from usual standards deserve extended comment. The first is the effect of climate on construction costs. The mild dry weather permits the lightest possible construction and reduces deterioration to a minimum. Buildings have usually no

foundations in the ordinary sense, but are erected on a light concrete slab that serves for both foundation and floor. Walls and roof are of galvanized iron on a light wooden frame. As there is no frost, buildings are unheated and piping need not be buried. The cost of such one-story construction in 1932 was 22c. per sq.ft.

The other advantage is one seldom mentioned. It is the skeleton in the closet of Los Angeles. More business enterprises fail here than in any other part of the country. Generally they are well engineered, but economically wrong. The result is that the district is strewn with the finest Eastern chemical apparatus that is technically second-hand stuff, though the term seems wrong to describe apparatus that in some cases has never even been set up. Some examples may be of interest. The Maas company bought a fine vacuum evaporator that had been operated only one day for 25 per cent of cost, and a calcining furnace that had never been operated, at an equal discount. When a new 50-ft. smokestack was needed, a Solvay carbonating tower from a failed soda plant was converted into probably the strongest steel stack in the country at a material cost of $100.

Eastern Plant Methods Not Used

Operation of the plant differs from the methods found best in the East. Methods of mass production are usually avoided. Continuous processes are usually not employed where good batch methods are available. The plant is shut down over each week-end except for one or two workmen. Processes requiring two 8-hr. shifts are often used, but 24-hr. operation with its inefficient "graveyard" shift is avoided almost entirely. The labor used is a high class of American workmen, and they are moved frequently from station to station about the plant, so that there are always experienced and competent men available for any operation. Hourly rates of pay, which are 55c. for process labor, have not been cut during the depression and the number employed has been moderately increased. This method of operation undoubtedly makes for high labor costs, but permits close regulation of production to accord with sales. In such times as these the defects of continuous mass production are more noticeable than its advantages.

The rate of obsolescence is unusually high, being about 30 per cent. Actual depreciation is not 10 per cent, but increasing sales and improvements in processes render apparatus rapidly unsuitable. It is hoped that the rate of obsolescence will in future decline through better planning.

Six soda salts are produced. The oldest is hypo, or sodium thiosulphate, which is produced for the motion picture industry, and to a less extent for chrome tanning. About 75 per cent of the films made in Hollywood are fixed with Maas hypo. The process is the standard one of burning sulphur, absorbing in soda ash solution, boiling with sulphur, filtering, concentrating, crystallizing, centrifuging, drying, and screening. Standard apparatus, such as a Glens Falls sulphur burner, brick-lined absorption towers, steel crystallizing pans, and others, are used. This simple process has resisted engineering innovations for generations. More careful control of quality than usual is needed to produce a photographic grade of hypo, but no special purification is called for.

Anhydrous sodium sulphite is made for the film studios and to a less extent for the mining trade. About 75 per cent of the movie films are made with Maas sulphite. The requirements of purity are unusually severe, exceeding usual laboratory reagent specifications.

The sulphite is made by direct crystallization of the anhydrous salt in a special process, for which patent application has been made. By very quick handling of the anhydrous crystal it is possible to centrifuge and dry it with so little oxidation that the finished product tests over 97 per cent Na_2SO_3.

Sodium carbonate monohydrate is made for the film studios by the standard process of dissolving soda ash and crystallizing in a salting-out evaporator. Careful control of quality to attain photographic standards is needed, but is not difficult.

Several sodium phosphates are made from 61-deg. Bé. Anaconda phosphoric acid, which is shipped from Montana to Los Angeles in steel tank cars. If the acid were only slightly diluted it would eat the steel car to pieces in a few hours. Disodium phosphate is made by the standard process of nearly neutralizing phosphoric acid with sodium carbonate (the natural desert ash being used), filtering, completing neutralization with caustic, refiltering, concentration and crystallization in a batch type mechanical cooling crystallizer. Western demands for the di-salt are small, as there is no silk industry. It is used for treating boiler waters, which in the Southwest are often so alkaline that disodium phosphate is more suitable than the tri-salt.

Trisodium phosphate is made in much larger tonnage. Some parts of the plant which could be difficult to enlarge later were built to a capacity of 80,000 lb. trisodium phosphate per day, while the "neck of the bottle" is the bank of crystallizers with a present capacity of 16,000 lb. per day. Owing to the non-corrosive nature of Anaconda phosphoric acid, it has been possible to construct the plant entirely of steel, which reduced the capital investment considerably. The plant was briefly described in *Chem. & Met.*, Vol. 36, p. 476, when constructed in 1928.

Packaging Trisodium Phosphate

Standard trisodium phosphate has the drawback for packaging or shipment in hot weather that it cakes badly. During recent years manufacturers have spent much attention on the problem and several excellent methods of preventing this difficulty have been worked out and patented. The Maas company's solution is to make a double salt of trisodium phosphate and sodium nitrate, in which about 3 per cent $NaNO_3$ replaces part of the water of crystallization. It has the further advantages of reduced causticity, lower vapor tension, somewhat greater detergent value, and better appearance. This product (U. S. patent No. 1,890,453) is finding a growing market in several states for household detergent and water-softening uses.

It has been the policy either to bring out a new product or reorganize an old process once a year. In the past five years four products have been added and two processes have been entirely reorganized. It is doubtful whether so strenuous a policy can be continued indefinitely, but the research department has enough irons in the fire to continue the policy for at least two or three years more.

Drying Gases By Absorption

The first of two articles covering the methods of carrying out this important unit operation; the second, to appear in March, will deal with drying by absorption, refrigeration and compression.

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REMOVAL OF MOISTURE from gases is a problem which most chemists and chemical engineers have often encountered in the course of their laboratory experiences. In principle, the problem is relatively simple and, in the laboratory, is usually solved without much difficulty. For the chemical engineer, however, the practical problem of drying gases is more complicated, especially when the advantages to be derived from drying are not wholly apparent. The specific problem of drying a particular gas or gas mixture may involve an intricate problem of general economics and a detailed knowledge of alternative processes for removing moisture and for the operation of the main process without such removal of moisture.

The proposal to dry air for blast furnaces was made 30 years ago by Gayley (Trans. Amer. Inst. Min. Eng., Vol. 35, 1904, p. 746) who worked out a well-considered process involving refrigeration. Several furnaces were built and operated with this system, but they were abandoned because economic conditions and technical conditions (improvements) have largely made the dry blast either unnecessary or of decreased importance. A second important large-scale application under consideration today is the drying of city illuminating gas. Several discussions of the subject have appeared in the literature and various plants have resorted to its use but the ultimate advantages are still debatable.

A third important application of drying technique is that of gases and gas mixtures which are to be used subsequently in catalytic processes. In this application of drying, the absence of water in the gas or gases is necessary in order to avoid: (1) the temporary or permanent inactivation of the catalyst; (2) the decreased absorption of a reaction product and consequent loss of material; and (3) corrosion caused by the presence of moisture. A fourth major application of drying agents is in the conditioning of air and other gases that are used in the chemical and physical processing of a large number of materials, such as dyestuffs, dye intermediates, textiles, and so on. The presence of moisture interferes with the production of solid carbon dioxide due to the formation of hexahydrated carbon dioxide ($CO_2.6H_2O$), which freezes at 110 deg. C. To avoid stoppages in the lines the moisture may be removed by sulphuric acid, calcium chloride, or silica gel (Littler, *Chem. and Ind.*, Vol. 52, 1933, p. 533).

The purposes of this paper are four-fold: first, to discuss in some detail the drying of gases by absorption; second, to make available new data on the partial pressures of water over aqueous phosphoric acid solutions; third, to present, in the convenient form of alignment charts, the pertinent available vapor-pressure data for the three liquid drying agents: sulphuric acid, glycerin, and phosphoric acid; and fourth, to tabulate in convenient form the available vapor-pressure and humidity-temperature data for (*a*) solid drying agents, and (*b*) saturated aqueous solutions of pure chemicals, of binary mixtures of pure chemicals, and of reciprocal salt pairs.

Technical methods of drying gases may be classified conveniently under the headings of (1) absorption, chemical or physical; (2) adsorption; (3) refrigeration; and (4) isothermal compression and expansion. The first method will be covered here and the last three, together with a discussion of the choice of drying methods, in a subsequent article.

No sharp distinction can be made between the chemical and physical absorption of water from gases. The transition from chemical to physical moisture-absorption processes is gradual: from the process of the absorption of moisture by phosphorus pentoxide, which is distinctly chemical, to the processes of absorption of moisture by sulphuric acid, metallic oxides and anhydrous salts, which are a combination of chemical and physical processes, to the process of the absorption of moisture by glycerin which is distinctly physical. The chief differences between the chemical and the physical processes are: (*a*) chemical absorption reduces the moisture content to a lower value than physical absorption; (*b*) chemical absorption involves a greater heat evolution than physical absorption; and (*c*) the difficulty of regeneration of the drying agent is greater for the chemical absorbent than for the physical absorbent.

A drying agent may be either a solid or a liquid. Solid materials present the difficulty that they cannot readily be circulated and, for a continuous process, two or more units must be provided, each so equipped that one is used for absorption while the other (or others) is being regenerated. Since such units are operated intermittently, their efficiency during the cycle may be variable inasmuch as the freshly regenerated absorbent is more efficient at the beginning of the cycle than toward the end. Also, in many cases at least, such solid absorbents gradually become less and less efficient as the number of cycles increases until the original absorbent must be replaced by new material. Finally, the process of transferring heat into the interior of a solid during the process of regeneration is obviously inefficient and presents many difficulties.

Liquid materials would seem to be most desirable for the drying of gases. They are easily circulated so that

Table I—Solid Drying Agents and Their Relative Humidities

Substance	Temperature, Deg. C.	Relative Humidity, Per Cent	Ref.*	Substance	Temperature, Deg. C.	Relative Humidity, Per Cent	Ref.*
$H_3PO_4 . \frac{1}{2}H_2O$	24.5	9	1	$(NH_4)_2SO_4$	20	81.0	7
$KC_2H_3O_2$	168	13	2	$(NH_4)_2SO_4$	30	81.1	7
$LiCl . H_2O$	20	15	1	$MgSO_4 . 6H_2O$	60	82	10
$CaCl_2 . 2H_2O$	50	17	3	$Na_2CO_3 . 10H_2O$	116	82.5	..
$MgCl_2 . 6H_2O$	110	18	..	$K_2C_4H_4O_6 . \frac{1}{2}H_2O$	60	84	9
$KC_2H_3O_2$	20	20	1	KBr	20	84	1
KF	100	22.9	4	$CuCl_2 . 2H_2O$	60	84	..
NaBr	100	22.9	4	Tl_2SO_4	104.7	84.8	9
$CaCl_2 . 6H_2O$	24.5	31	1	$MgSO_4 . 6H_2O$	50	85	10
$CaCl_2 . 6H_2O$	20	32.3	3	$MnSO_4 . H_2O$	30	85	10
CrO_2	20	35	1	$NaKC_4H_4O_6 . 4H_2O$	40	85.5	11
$MgCl_2 . 6H_2O$	10	35	1	$KHSO_4$	20	86	1
$CaCl_2 . 6H_2O$	10	38	3	$Na_2CO_3 . 10H_2O$	24.5	87	1
$Zn(NO_3)_2 . 6H_2O$	20	42	1	$CuSO_4 . 5H_2O$	100	87.5	..
$K_2CO_3 . 2H_2O$	24.5	43	1	$KClO_3$	100	87.5	..
$K_2CO_3 . 2H_2O$	18.5	44	1	$NaKC_4H_4O_6 . 4H_2O$	20	87.5	11
KNO_2	20	45	1	KCl	0	88	..
KCNS	20	47	1	K_2CrO_4	20	88	1
$CoCl_2 . 6H_2O$	50	49	5	$BaCl_2 . 2H_2O$	24.5	88	1
NaI	100	50.4	4	$Pb(NO_3)_2$	103.5	88.4	2
$Ca(NO_3)_2 . 4H_2O$	24.5	51	1	$K_2C_4H_4O_6 . \frac{1}{2}H_2O$	30	89	9
$NaNO_2$	120	51	..	$CuCl_2 . 2H_2O$	30	89.5	..
$Na_2Cr_2O_7 . 2H_2O$	20	52	1	$CoSO_4 . 6H_2O$	50	90	10
$Mg(NO_3)_2 . 6H_2O$	24.5	52	1	$ZnSO_4 . 7H_2O$	20	90	1
$NaHSO_4 . H_2O$	20	52	1	$MnSO_4 . H_2O$	60	91	10
$NaClO_3$	100	54	4	$NaC_4H_5O_6 . 2H_2O$	40	92	11
$Ca(NO_3)_2 . 4H_2O$	18.5	56	1	K_2HPO_4	20	92	1
$Mg(NO_3)_2 . 6H_2O$	18.5	56	1	$NaC_4H_4O_6 . 2H_2O$	20	92	..
KI	100	56.2	4	$NaBrO_3$	20	92	1
KNO_3	115	58	..	$Na_2CO_3 . 10H_2O$	18.5	92	1
$NaBr . 2H_2O$	20	58	1	$(NH_4)_3PO_4$	30	92.9	..
$Mg(C_2H_3O_2)_2 . 4H_2O$	20	65	1	$Na_2SO_4 . 10H_2O$	20	93	1
$NaNO_3$	20	66	1	$(NH_4)_2PO_4$	25	93	7
$CoCl_2 . 6H_2O$	20	69	5	$(NH_4)_2PO_4$	20	93.1	7
KBr	100	69.2	4	$ZnSO_4 . 7H_2O$	5	94.7	12
NH_4NO_3	0	72.0	6	$CoSO_4 . 6H_2O$	90	95	10
NaCl	110	74	..	$Na_2HPO_4 . 12H_2O$	20	95	1
KCl	110	75	..	$CuSO_4 . 5H_2O$	60	95	..
$(NH_4)_2SO_4$	108.2	75	7	K_2SO_4	100	95	1
$NaClO_3$	20	75	1	$Na_2SO_3 . 7H_2O$	20	95	..
$H_2C_2O_4 . 2H_2O$	20	76	1	$KClO_3$	40	96	..
$NaC_2H_3O_2 . 3H_2O$	20	76	1	KNO_3	0	96	4
$Na_2S_2O_3 . 5H_2O$	20	78	..	NaF	100	96.6	1
$Na_2CO_3 . 10H_2O$	40	78	..	$CaSO_4 . 5H_2O$	20	98	1
NaCl	0	78	..	$Pb(NO_3)_2$	20	98	..
$(NH_4)_2SO_4$	20	79.2	7	K_2SO_4	10	98	9
$(NH_4)_2SO_4$	30	79.5	7	$TlNO_3$	100.3	98.7	9
$NaNO_2$	0	80	9	TlCl	100.1	99.7	1

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one unit designed for continuous absorption and one unit for regeneration, together with circulating pumps, would permit continuous operation. Liquids are readily dispersed by sprays or distributed over tower packings in order to insure that a large surface of the liquid is in contact with the gas. Finally, the heat required for the regeneration of the liquid absorbent from its mixture with water is efficiently transferred to such a fluid mixture.

The types of solids that may be used for drying by chemical or physical absorption may be divided into three well-defined classes: (*a*) salts capable of forming hydrates; (*b*) metallic oxides and hydrated oxides; and (*c*) acidic oxides. Of the acidic oxides, phosphorus pentoxide is the most important, and is the most effective in securing complete desiccation. Its use and preparation are well described in several articles (Baker, *J. Chem. Soc.*, 1929, p. 1661; Boni, *Ibid.*, 1929, p. 1664; Finch and Fraser, *Ibid.*, 1926, p. 117). The hydrated metallic oxides are also very effective in drying, but in the presence of carbon dioxide they form carbonates which are generally worthless. Of the hydroxides, only those which are highly soluble, such as sodium or potassium hydroxides, can be used and they have a tendency to form a surface coating which reduces their effectiveness. Metallic salts which form hydrates are very numerous and are satisfactory where a moderate degree of desiccation is required. Even salts which do not form hydrates may be used for drying since every dry salt will absorb moisture, provided the partial pressure of water vapor in the atmosphere to which it is exposed is greater than the partial pressure of water over its saturated solution. In general, those salts which have the highest molar solubility will be the best drying agents.

A list of solid drying agents and their relative humidities arranged in the order of increasing humidities at different temperatures is given in Table I which has been compiled from the literature by A. T. Krause, librarian of the Grasselli Chemical Co., and is included here by permission of E. A. Taylor, chemical director of the company. The precision of the data is not very great in a number of cases and there are some contradictory data. Nevertheless, the list gives a good indication of the materials that may be used to produce a desired degree of dessiccation. Table II (from "International Critical Tables," Vol. 3, p. 385) gives the relative efficiencies of some of the more common drying agents.

When a mixture of two or more water-absorbing sub-

Table II—Relative Efficiencies of Drying Agents*

(Milligrams of residual water per liter of gas dried at 25 deg. C.)

Drying Agent	Mg. Water	Drying Agent	Mg. Water
A filter at —194 degrees C.	1.6×10^{-23}	H_2SO_4	0.003
P_2O_5	$<2 \times 10^{-6}$	MgO	0.008
$Mg(ClO_4)_2$	$<5 \times 10^{-4}$	NaOH (fused)	0.16
$Mg(ClO_4)_2 . 3H_2O$	$<2 \times 10^{-3}$	$CaBr_2$	0.2
KOH (fused)	0.002	CaO	0.2
Al_2O_3	0.003	$CaCl_2$ (granular)	0.14—0.25

*"International Critical Tables," Vol. 3, p. 385.

Table III—Vapor Pressures and Relative Humidities of Saturated Aqueous Solutions of Binary Mixtures; and Relative Humidities of Saturated Aqueous Solutions of Components at 30 Deg. C.

Binary Mixture	—Binary Mixture— Vapor Pressure Saturated Solution, Mm. Hg	Relative Humidity of Air in Eq. With Saturated Solution	—Components— Relative Humidity of Saturated Solutions First	Second
$NH_4NO_3 + CO(NH_2)_2$	5.75	18.1	59.4	72.5
$NH_4NO_3 + Ca(NO_3)_2 . 4H_2O$	7.48	23.5	59.4	46.7
$Ca(NO_3)_2 . 4H_2O + KNO_3$	10.00	31.4	46.7	90.5
$Ca(NO_3)_2 . 4H_2O + NaNO_3$	12.00	37.7	46.7	72.4
$NaNO_3 + CO(NH_2)_2$	14.49	45.6	72.4	72.5
$Ca(NO_3)_2 . 4CO(NH_2)_2 + Ca(NO_3)_2 . 4H_2O$	14.56	45.7	66.7	46.7
$Ca(NO_3)_2 . 4H_2O + CaH_4(PO_4)_2 . H_2O$	14.71	46.2	46.7	93.7
$NH_4NO_3 + NaNO_3$	14.75	46.3	59.4	72.4
$NH_4NO_3 + NH_4Cl$	16.38	51.4	59.4	77.2
$CO(NH_2)_2 + NaCl$	16.82	52.8	72.5	75.2
$CO(NH_2)_2 + (NH_4)_2SO_4$	17.95	56.4	72.5	79.2
$Ca(NO_3)_2 . 4CO(NH_2)_2 + CO(NH_2)_2$	17.99	56.5	67.7	72.5
$CO(NH_2)_2 + NH_4Cl$	18.42	57.9	72.5	77.2
$NH_4NO_3 + NH_4H_2PO_4$	18.46	58.0	59.4	91.6
$NH_4NO_3 + KNO_3$	19.07	59.9	59.4	90.5
$CO(NH_2)_2 + KCl$	19.20	60.3	72.5	84.0
$NH_4NO_3 + (NH_4)_2SO_4$	19.82	62.3	59.4	79.2
$NaNO_3 + KNO_3$	20.55	64.5	72.4	90.5
$CO(NH_2)_2 + CaH_4(PO_4)_2 . H_2O$	20.73	65.1	59.4	93.7
$CO(NH_2)_2 + KNO_3$	20.77	65.2	59.4	90.5
$CO(NH_2)_2 + NH_4H_2PO_4$	20.77	65.2	59.4	91.6
$Ca(NO_3)_2 . 4CO(NH_2)_2$	21.25	66.7	....	....
$NaNO_3 + NaCl$	21.53	67.6	72.4	75.2
$NaCl + NH_4Cl$	21.91	68.8	75.2	77.2
$CO(NH_2)_2 + KH_2PO_4$	22.32	70.1	59.4	92.9
$NH_4Cl + (NH_4)_2SO_4$	22.70	71.3	77.2	79.2
$CO(NH_2)_2 + K_2SO_4$	22.77	71.5	59.4	96.3
$NaCl + KCl$	22.98	72.2	75.2	84.0
$NH_4Cl + KCl$	23.39	73.5	77.2	84.0
$NH_4Cl + NH_4H_2PO_4$	23.68	74.4	77.2	91.6
$(NH_4)_2SO_4 + NH_4H_2PO_4$	24.13	75.8	79.2	91.6
$KCl + KNO_3$	25.01	78.6	84.0	90.5
$(NH_4)_2SO_4 + K_2SO_4$	25.92	81.4	79.2	96.3
$KCl + K_2SO_4$	26.48	83.2	84.2	96.3
$KCl + KH_2PO_4$	26.55	83.4	84.2	92.9
$KNO_3 + K_2SO_4$	27.97	87.8	90.5	96.3
$NH_4H_2PO_4 + CaH_4(PO_4)_2 . H_2O$	28.26	88.8	91.6	93.7
$KNO_3 + KH_2PO_4$	28.71	90.1	90.5	92.9
$KH_2PO_4 + CaH_4(PO_4)_2 . H_2O$	28.82	90.5	92.9	93.7
$NH_4H_2PO_4 + KH_2PO_4$	28.99	91.0	91.6	92.9
$KH_2PO_4 + K_2SO_4$	29.86	93.8	92.9	96.3

Table IV—Vapor Pressures of, and Relative Humidities of Air in Equilibrium With, Saturated Aqueous Solutions of Pure Chemicals

Substance	Vapor Pressures of Saturated Aqueous Solutions, Mm. Hg — Temperature, Deg. C.							Relative Humidity of Air in Equilibrium With Saturated Aqueous Solutions, Per Cent — Temperature, Deg. C.						
	10	15	20	25	30	40	50	10	15	20	25	30	40	50
$Ca(NO_3)_2.4H_2O$	....	7.16	9.73	12.04	14.88	19.68	....	....	55.9	55.4	50.5	46.7	35.5	....
NH_4NO_3	6.88	8.95	11.74	14.94	18.93	29.11	44.71	75.3	69.8	66.9	62.7	59.4	52.5	48.4
NaCl	7.00	9.87	13.63	18.01	23.96	41.37	68.50	76.6	77.0	77.6	75.5	75.2	74.7	74.1
$NaNO_3$	7.13	9.85	13.53	17.73	23.07	38.81	62.21	78.0	76.8	77.1	74.4	72.4	70.1	67.3
NH_4Cl	7.27	10.15	13.92	18.12	24.61	40.81	65.92	79.5	79.2	79.3	76.0	77.2	73.7	71.3
$(NH_4)_2SO_4$	7.29	10.16	14.22	19.50	25.22	43.32	71.93	79.8	79.3	81.0	81.8	79.2	78.2	77.8
$CO(NH_2)_2$	7.48	10.24	14.05	18.06	23.09	37.66	57.77	81.8	79.9	80.0	75.8	72.5	68.0	62.5
KCl	8.07	11.05	15.04	19.89	26.75	44.99	73.97	88.3	86.2	85.7	83.4	84.0	81.2	80.0
KNO_3	8.87	12.26	15.21	21.94	28.84	48.67	78.56	97.0	95.6	92.3	92.0	90.5	87.9	85.0
$NH_4H_2PO_4$	8.94	12.44	16.10	21.91	29.18	50.05	81.56	97.8	97.0	91.7	91.9	91.6	90.3	88.2
$CaH_4(PO_4)_2.H_2O$	8.95	12.67	16.52	22.89	29.85	52.37	87.50	97.9	98.8	94.1	96.0	93.7	94.5	94.6
KH_2PO_4	8.96	12.62	16.89	22.76	29.60	51.46	85.63	98.0	98.4	96.2	95.4	92.9	92.9	92.6
K_2SO_4	9.06	12.78	17.30	23.56	30.68	53.04	88.57	99.1	99.7	98.5	98.8	96.3	95.7	95.8

stances is used for drying it is not possible to predict the vapor pressure of the saturated solution from the vapor pressures of the saturated solutions of the individual components. A suggestive experimental investigation has been published by Adams and Merz (*Ind. Eng. Chem.*, Vol. 21, 1929, p. 305) from whose data Table III* has been compiled. In this the pairs of salts are arranged in the order of increasing vapor pressures of their saturated solutions and in the order of increasing relative humidities of their saturated solutions.

In the same article the authors also report upon the effect of temperature upon the drying power, the results of which are given in Table IV, in which the substances are arranged in the order of increasing vapor pressures and in the order of increasing relative humidities of air in equilibrium with their saturated aqueous solutions. The data indicate that the relative humidity decreases as the temperature increases. However, this point is not particularly important since the absolute humidity (the amount of water per unit volume of gas) will in all cases decrease with a lowering of the temperature, and for this reason it is obviously important to carry out the drying at as low a temperature as possible.

The mixtures considered above (Table III) are those that have a common ion. When there is no common ion, we have the case of the so-called reciprocal salt pairs and the relations are more complicated. Thus, considering an extreme case, $BaCl_2$ and Ag_2SO_4 would both have some water-absorbing powers, but in a mixture they would immediately react to give the insoluble compounds, $BaSO_4$ and AgCl, which would have no hygroscopicity. The hygroscopicities of such mixtures have been studied by Merz, Fry, Hardesty and Adams (*Ind. Eng. Chem.*, Vol. 25, 1933, p. 136) and their results in part are summarized in Table V. Such mixtures are perhaps most conveniently regarded as composed of the three least soluble salts which can form and an examination of the data indicates that the relative humidities are *lower* than those for mixtures involving only two salts. Thus $NaNO_3$ and NH_4Cl, which have individual relative humidities of 72.4 and 77.2 per cent respectively at 30 deg. C. will give a mixture with a relative humidity of 53.0 per cent when solid NaCl is present and 43.2 per cent with solid NH_4NO_3, both of which are lower than the relative humidity of so hygroscopic a substance as NH_4NO_3. This indicates the advantage of adding other salts.

*A study of these data indicates that in *most* cases the relative humidity of the mixtures is lower than that of the components and, in *all* cases, is lower than that of the most hygroscopic component. The most striking exceptions relate to ammonium nitrate which is the most hygroscopic of the salts studied. The behavior of urea, $CO(NH_2)_2$, in mixtures is especially noteworthy; although not particularly hygroscopic itself, the relative humidity of air in equilibrium with the mixture is very markedly lowered.

Table V—Vapor Pressures of, and Relative Humidities of Air in Equilibrium With, Saturated Aqueous Solutions of Reciprocal Salt Pairs at 30 Deg. C.

Stable Salt Pair	Salt in Equilibrium With Stable Salt Pair	Vapor Pressure of Solution, Mm. Hg	Relative Humidity of Air in Eq. With Solution
$Ca(NO_3)_2.4H_2O + (NH_4)_2SO_4$	$CaSO_4.2H_2O$	9.06	28.5
	NH_4NO_3	7.45	23.4
$Ca(NO_3)_2.4H_2O + KCl$	KNO_3	9.06	28.5
	$CaCl_2.6H_2O$	7.00	22.0
$Ca(NO_3)_2.4H_2O + KH_2PO_4$	KNO_3	14.91	46.8
	$CaH_4(PO_4)_2.H_2O$	14.82	46.6
$NH_4NO_3 + KH_2PO_4$	KNO_3	19.17	60.2
	$NH_4H_2PO_4$	19.09	60.0
$NH_4NO_3 + CaH_4(PO_4)_2.H_2O$	$NH_4H_2PO_4$	17.14	53.84
	$Ca(NO_3)_2.4H_2O$	7.46	23.43
$NH_4NO_3 + Na_2SO_4.10H_2O$	$NaNO_3$	21.52	67.6
	$(NH_4)_2SO_4$	17.15	53.9
$NaNO_3 + NH_4Cl$	NaCl	16.87	53.0
	NH_4NO_3	13.76	43.2
$NaNO_3 + NH_4H_2PO_4$	$NaH_2PO_4H_2O$	21.20	66.6
	NH_4NO_3	15.17	47.7
$NaNO_3 + KH_2PO_4$	KNO_3	20.92	65.7
	$NaH_2PO_4.H_2O$	20.80	65.3
$NaNO_3 + CaH_4(PO_4)_2.H_2O$	$NaH_2PO_4.H_2O$	22.53	70.8
	$Ca(NO_3)_2.4H_2O$	11.60	36.4
$NaNO_3 + K_2SO_4$	$Na_2SO_4.10H_2O$	23.40	73.5
	KNO_3	21.25	66.8
$NaCl + KNO_3$	KCl	21.22	66.7
	$NaNO_3$	19.59	61.5
$NH_4Cl + KNO_3$	KCl	21.30	66.9
	NH_4NO_3	17.25	54.2
$NH_4Cl + CaH_4(PO_4)_2.H_2O$	$NH_4H_2PO_4$	23.12	72.6
	$CaCl_2.6H_2O$	7.96	25.0
$NH_4Cl + K_2SO_4$	KCl	22.99	72.2
	$(NH_4)_2SO_4$	22.83	71.7
$(NH_4)_2SO_4 + KNO_3$	K_2SO_4	23.12	72.6
	NH_4NO_3	18.74	58.9
$(NH_4)_2SO_4 + CaH_4(PO_4)_2.H_2O$	$NH_4H_2PO_4$	24.66	77.5
	$CaSO_4.2H_2O$	24.62	77.3
$KCl + NH_4H_2PO_4$	KH_2PO_4	25.08	78.8
	NH_4Cl	23.00	72.2
$KCl + CaH_4(PO_4)_2.H_2O$	KH_2PO_4	25.82	81.1
	$CaCl_2.6H_2O$	7.00	22.0
$KNO_3 + CaSO_4.2H_2O$	K_2SO_4	16.54	51.3
	$Ca(NO_3)_2.4H_2O$	9.75	30.7
$KH_2PO_4 + CaSO_4.2H_2O$	$CaH_4PO_4.H_2O$	29.96	94.1
	K_2SO_4	29.92	94.0
$K_2SO_4 + NH_4H_2PO_4$	KH_2PO_4	27.99	87.9
	$(NH_4)_2SO_4$	25.28	79.4

When double salts can form between two salts with a common ion, the total salt concentration is less than that of the solution saturated with respect to both the individual salts, but it would be possible for this concentration to be higher than that of the saturated solution of any one salt. Consequently, the relative humidity might well be lower.

Almost any liquid which is miscible with water in all proportions is capable of effecting some drying, but the further requirement that its vapor pressure must be so low as to introduce no appreciable impurity into the gas stream limits the substances that may be used to those that have comparatively high boiling points, such as sulphuric acid, glycerin, and phosphoric acid. Saturated salt solutions may also be used for drying, but will obviously give less complete drying than the solid salts. On the other hand, anhydrous liquids may give any desired reduction of the moisture content with the prac-

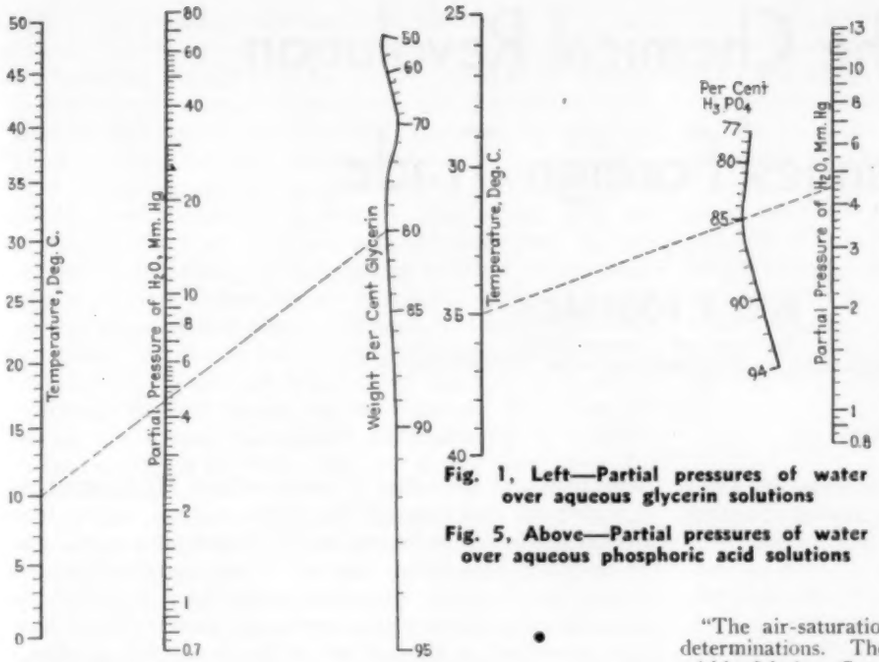


Fig. 1, Left—Partial pressures of water over aqueous glycerin solutions

Fig. 5, Above—Partial pressures of water over aqueous phosphoric acid solutions

tical limitation that a vanishingly small humidity can be attained only with excessive quantities of drying agent.

The technically most important liquid drying agents are glycerin, sulphuric acid and phosphoric acid and because of their importance it has seemed worthwhile to construct alignment charts* showing the variation of vapor pressures with the temperature and with the concentration of the aqueous solutions. The chart for glycerin (Fig. 1) was constructed from the data of Darke and Lewis (*Chem. & Ind.*, Vol. 47, 1928, p. 1073) and Steadman (Trans. Faraday Soc., Vol. 24, 1928, p. 289). The charts for sulphuric acid are based on the data of the "International Critical Tables," Vol. 3, pp. 303-4. Fig. 2 gives the total vapor pressures of sulphuric acid as a function of the temperature and the concentration; Fig. 3 gives the partial pressures of water over sulphuric acid solutions as a function of the temperature and the concentration; and Fig. 4 gives the partial pressures of sulphur trioxide over sulphuric acid solutions (fuming acids) as a function of the temperature and the concentration. The chart for phosphoric acid (Fig. 5) was constructed from data kindly supplied by The Victor Chemical Works in whose laboratories W. H. Woodstock made the necessary measurements. Commenting on these measurements in a private communication to the authors, Mr. Woodstock wrote:

"The air-saturation method was used for the vapor-pressure determinations. The water thermostat used was maintained to within 0.1 deg. C. of the temperature desired. In this bath the saturator, containing the phosphoric acid solution being studied, was immersed. Air, dried by passage through granules of fused calcium chloride, was passed (through a porous disk sealed into the bottom of the saturator) into the acid, thence through a P_2O_5 drying-tube, and finally through a calibrated wet test meter. Equilibrium conditions were assured by decreasing the rate of air flow through the saturator until no further change in the partial pressure of water vapor was observed.

"The concentrations of phosphoric acid used in these studies were: 75, 85, 90 and 95 per cent H_3PO_4 by weight and the temperatures at which the vapor pressures were determined were 25, 30, and 35 deg. C. The 90 and 95 per cent H_3PO_4 solutions were prepared by combining pure crystalline H_3PO_4 and C.P. 85 per cent H_3PO_4. The 75 per cent H_3PO_4 solution was prepared from the C.P. 85 per cent H_3PO_4 and distilled water. The 72 per cent H_3PO_4 solution was that manufactured in one process of The Victor Chemical Works. All acids used in the vapor-pressure determinations were analyzed before and after each determination in order to be sure that no change in concentration had occurred during the experiment."

*For the preparation of these alignment charts we are indebted to D. S. Davis of D. S. Davis' Associates, East Northfield, Mass. The charts are best read with a thin straight line ruled on a piece of flimsy.

Fig. 2—Total vapor pressure of aqueous sulphuric acid solutions

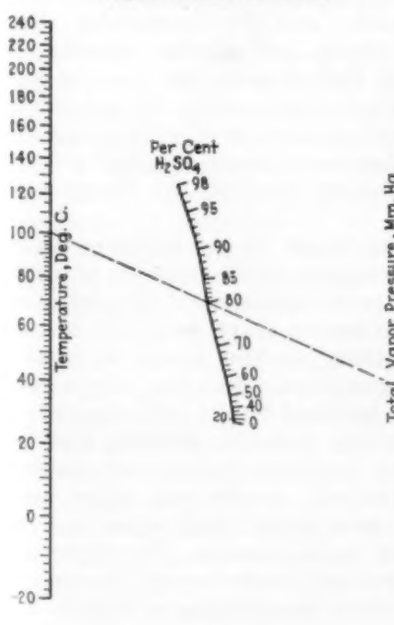


Fig. 3—Partial pressures of water over aqueous sulphuric acid solutions

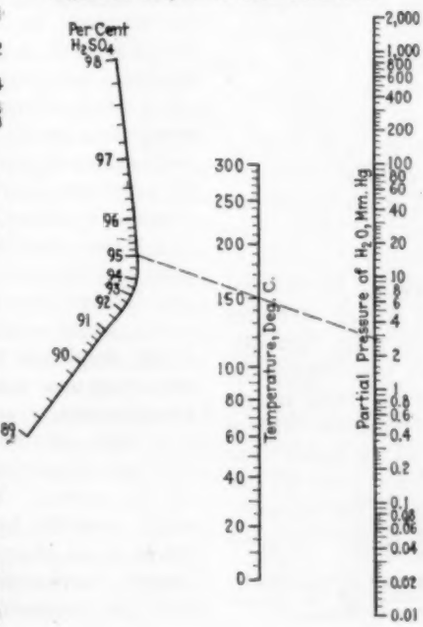
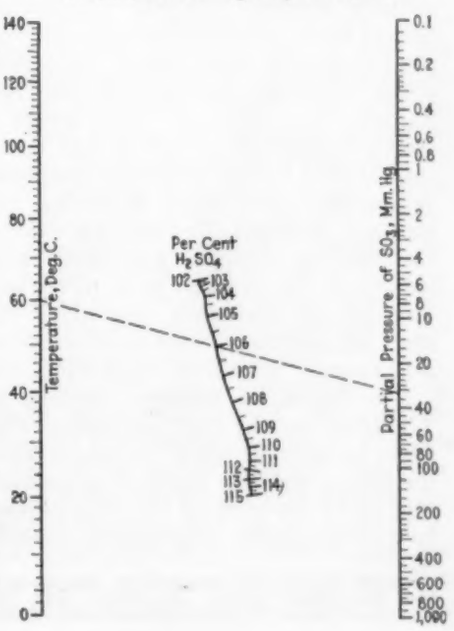


Fig. 4—Partial pressures of sulphur trioxide over fuming sulphuric acid



How the Chemical Revolution Changes Foreign Trade

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WRITING of the economic situation in Chile, the British Commercial Secretary at Santiago said at the end of 1932:

> Chile's most cherished possession—her international credit—has been swept completely away. . . . Her foreign commerce has fallen to comparatively negligible figures. . . Her gold standard has gone and the peso has no recognized international exchange value. . . . Steamship services . . . have been reduced to a minimum, and an already remote Chile is left more isolated than ever. . . . The great workmen's encampments in the nitrate pampas of the north are largely depopulated, and hungry men, women and children have made their way to the central zone in search of food and shelter. . . . President Montero's constitutional government from which so much was hoped, has been forcibly ejected, and the long reign of the aristocratic oligarchy has been superseded by the Socialist Republic of Chile.

Back of this picture of economic, political and social chaos in a once prosperous country lie many causes, but chief among them, aside from the great world depression itself, is the development of methods for artificial production of sodium nitrate. The nitrate trade, originally created by the chemist's discovery of the value and use of inorganic nitrate fertilizer in the middle of the last century, turned Chile into a prosperous country which forged ahead as one of the most progressive, most stable, most promising countries of South America. Then, as a result of further discoveries by the chemist and engineer, namely, the synthetic manufacture of nitrogen, the country's vaunted prosperity and economic and political stability were threatened with complete collapse. The developments and changes in the use and manufacture of nitrogen products illustrate the changes and shifts that the chemical revolution has caused in economic and political conditions of many parts of the world, in the flow of international commerce, and in all the varied activities that are associated with commerce—shipping, banking, investments, insurance, marketing, and manufacturing.

The export of nitrates, reaching at its peak nearly 3,000,000 tons in 1929, dominated the economic life of Chile for over 50 years. Up to the end of the Great War the nitrate industry normally accounted for from 65 per cent to 75 per cent of the total exports of the country. It gave profitable employment directly to an army of workmen and indirectly to many others. It spurred the agricultural industry of the fertile central valley from which foods had to be sent to the desert nitrate officinas; it laid the foundation for a Chilean merchant marine operating along an extensive coast line; it caused the building of a dozen nitrate ports and their railroad feeders; provided, to a large extent, the means for constructing the longitudinal railway of Chile; and in numerous other ways stimulated her economic and cultural life.

The developing nitrate industry created in turn a large and growing import trade since exports furnished the where-with-all to make purchases from abroad. Large amounts of these imports were, of course, machinery, equipment and supplies for the nitrate industry itself. Coal for fuel, chiefly from England but also from Australia and other sources, came in tremendous tonnages, providing return cargoes for the nitrate boats. Later petroleum fuels supplemented or supplanted coal and stimulated petroleum production and imports from Peru, the Caribbean countries, and southern California. Jute bags for shipping nitrates flowed in in shipload quantities from India, creating a new trade of great volume and value and stimulating a great industry in that Far Eastern country. Machinery for nitrate mining and equipment materials of every description—steam shovels, boilers, structural steel, building supplies, cement, tools, locomotives, motor trucks, and the innumerable other supplies that a great mining and refining industry required—came from the United States and the countries of western Europe in a growing flood. In addition to equipment goods, imports of consumers' goods and foods in great variety and from many countries surged upward in response to the growing standards of living made possible by nitrates.

All these imports contributed, of course, to the industrial and commercial prosperity of the countries of origin and further stimulated trade, industry and shipping in all parts of the world. In banner years, from 600 to over 1,000 shiploads of nitrates per year would be moved, requiring vast tonnages of ships. Since the bulky export requirements could be balanced by the bulky import of coal and equipment, it was profitable shipping that the Chilean nitrate industry furnished the merchant marines of the world. The frequent services and better rates made possible by the new nitrate trade stimulated the trade of all of southern South America. The nitrate industry furthermore required much foreign investment and the payments on these investments, of course, are

Based on a paper presented at the symposium on "The Chemical Revolution" at the December, 1933, meeting of the American Association for the Advancement of Science, Boston.

dependent upon the maintenance of nitrate exports. Since from 50 to 60 per cent of the government revenues were derived from export taxes on nitrate products, the nitrate industry was not only of great importance to private commercial interests; it was also vital directly to the financial stability of the Chilean government.

With the economic and financial life of Chile, both public and private, so intimately intertwined with the nitrate industry, it of course was inevitable that any developments affecting, or threatening to affect, the supremacy of natural sodium nitrate as a fertilizer and chemical raw material should react profoundly not only on Chilean government finances but on the world structure of trade, industry, shipping and finance that has grown up about nitrates. Such a threat was the chemists' discovery and recent perfection of methods of producing by artificial means nitrogen products that are direct substitutes for the natural product.

Chilean nitrate is but one illustration of the effect on the expansion of world trade by scientific discovery. The chemist's researches in the uses of vegetable oils added to international trade literally tens of millions of tons of cargo. In 1908, an experimental shipment of 100 tons of soy beans from Dairen was made to Liverpool. By 1920 the exports of soy beans, bean cake and bean oil from Manchuria had reached the tremendous total of well over 3,000,000 tons yearly for destinations that included the whole industrial world, East and West. Hundreds of ships and thousands of railroad cars were engaged in the traffic. The effects of the soy bean trade alone on the food supply of peoples, on agricultural methods, on industrial practices, on the shipping industry, on finance, on international relations in the Far East, are startling in extent and importance. The soy bean greatly augmented the vegetable oil industries of Europe; fed the cattle of Scandinavia and helped make possible the great advance in the export trade of these countries in dairy and animal products; made possible the more intensive agriculture of Japan, and enabled Manchuria to triple its population in two decades and become one of the important agricultural exporting and consuming areas of the world.

New Conditions Create New Demands

Not only in volume has trade increased with scientific advances, but in its variety and geographical distribution. New conditions create new demands and science comes to industry's aid. The machine age demands stronger or harder or tougher or lighter steels, or steels that will resist wear and corrosion; and lo! as a result of scientific research, the steamships of the world are bearing to the iron and steel centers from the seven continents manganese, chrome, silicon, tungsten, vanadium, zirconium, molybdenum, nickel and cobalt. The alloy steels alone have created, largely since 1900, a widely extended trade of great volume and value. Some of the steel alloying ores and metals can be secured only by imports; others that can be locally produced may involve costs that would handicap the domestic steel industries. Without trade, the chemists' response to industry's demand often would be impossible.

But, as far as foreign trade is concerned, science giveth and science also taketh away. The development of synthetic nitrogen, as we have seen, now threatens to destroy the very trade the chemist originally developed. The factory, in response to new chemical improvements, is displacing the Chilean deposits. The once important trade in natural indigo has nearly vanished in India; the laboratory produces the synthetic products and artificial indigo is imported even into India. Camphor, the consumption of which was so largely increased by the discovery of Celluloid, comes in decreasing quantities from the camphor trees of Japan and Formosa; it too is now a product of the laboratory. Alizarin has displaced the madder plant; viscose is taking the place of silk and wool and isinglass and paper. Synthetic petroleum, synthetic rubber and many other products appear to be within the range of possible commercial exploitation and as they develop will displace important trades now established.

Does Research Lessen Trade?

In spite of the developments of the character just mentioned, however, it is not apparent that synthetic products are lowering the volume or narrowing the distribution of foreign trade. Doubtless in some instances this is, or may be, the result; but in other cases the opposite is as clearly the case. With the constant expansion of human demands as science and invention perfect new and better and cheaper products, international trade intercourse increases in extent, variety and urgency, and doubtless also in actual volume.

There are three main reasons for this assertion. First, modern scientific industry is particular in its demands for the material of the exact quality necessary to give the desired finished product. Often only one or a few localities contains or can readily produce the product that exactly fills the requirements. Such, for example, is tungsten for alloy-steel, or palm oil in the manufacture of tin plate, or natural rubber for automobile tires. Secondly, economies in production require materials from the sources best able to produce them. Local substitutes or local synthetic products, if they can be produced only at higher costs or are inferior in quality, can be used only at the sacrifice of efficiency in industry and consequently at the expense of higher standards of living.

Attempts to substitute other types of domestic steel for Swedish steel have had to be abandoned after trial when the product is required for highly specialized uses such as ball bearings and certain kinds of cutlery. And yet chemical analysis fails to reveal any difference in the composition of the domestic electric refined steel and the Swedish article. There appears to be some, as yet unknown, quality in the one that is absent in the other—a quality that may be analogous to vitamins in food. Such fine distinctions in the quality of many raw materials required to meet the exacting requirements of highly scientific industries make trade, not permissive, but mandatory; and new refinements in products are constantly expanding the number of such instances, constantly broadening the reaches of international commerce.

Thirdly, the synthetic industries themselves set up flows of trade, both export and import, that counterbalance or overbalance the declines in trade resulting from the supplanting of the natural product. Synthetic products require raw materials for their production and in addition power—frequently very large amounts of power. The new synthetic industry may change the kinds and the sources of raw materials and take industries from old localities and establishes them in new

surroundings. The avenues of trade may be shifted and the trade may be changed in character, but it is not destroyed nor even necessarily lessened. In fact, a new synthetic product or a new method of production may, and does, create new trade. This too is illustrated by the development of synthetic nitrogen.

The change in method of nitrate production, by transferring the nitrate production to new centers, sets up new trade routes and inaugurates or increases trade in new commodities. The manufacture of synthetic nitrogen by the two most important commercial methods—the by-product and Haber processes—requires abundant coal and cheap power, either coal or hydroelectric. The new industry must, therefore, locate chiefly in the regions accessible to coal, i.e., the sections already most highly developed industrially—Great Britain, Central Europe, and eastern United States—or else in regions that will require an enlarged import trade in coal. The former is what is occurring and is likely to continue to be the case, since the bulky coal is the chief raw material and therefore is likely to be the chief determining factor in location. Thus one more industrial advantage is given to regions already blessed as industrial areas, further enlarging their need for developing exports.

But whether located in the coal areas or not, the newly established industry stimulates much new trade, both import and export. Demands for new and specialized equipment and supplies, must be imported or, if locally produced, require greater or less amounts of imported materials for their production. For example, among the chemicals required in the synthetic processes, sulphuric acid, although of diminishing importance in the fertilizer industry, still is a prime necessity and its production requires large tonnages of sulphur in some form, either as pyrites from Spain or as native sulphur from the United States or Italy. Largely as a result of the growth of the synthetic nitrogen industry, German imports of sulphuric acid increased from 89,000 metric tons in 1930 to 141,000 tons in 1932 and 117,000 tons for the first half of 1933. British imports of pyrites and sulphur, much of which was for the fertilizer industry, increased from 1931 to 1933 more than enough to counterbalance the declines in imports of Chilean nitrates.

The newly located nitrogen industry also sets up new channels of export. The transfer of the industry from Chile does not diminish world demand for nitrate fertilizers or other nitrogen products. Rather, as far as the new method in the new areas cheapens and improves the product, consumption in the great agricultural areas of the world will be materially increased. Since many of these consuming areas, like Argentina and Brazil have no or little coal, they have little prospects of producing their own nitrogen, and therefore must continue to depend on outside sources but the new importations will be, as the transfer occurs, from Europe or the United States and not from Chile. If the nitrogen industry becomes localized in those areas which by virtue of their coal resources, their superior abilities in industrial experience, organization and technique are able to produce more cheaply, then a large export movement out of the new nitrate producing countries to the non-producing areas would be inevitable. This is what actually is happening already. With the synthetic nitrogen industry only at its beginnings in the United States, and in spite of the world depression, the United States exported in 1932, 181,000 tons of chemical nitrogen fertilizers as against 132,000 tons in 1931, and 107,000 tons in 1930. In 1932, 27 cargo vessels took synthetic sodium nitrate from Hopewell, Virginia, to the Far East, Great Britain, France and Spain—an amount greater for that year than our imports of sodium nitrates from Chile.

The importance of coal in the new chemical developments, especially of synthetic products, is a significant fact. It has already been pointed out that the synthetic nitrogen industry largely depends on coal as a raw material. Others of the most important and most promising synthetic products likewise rest on coal or coal products in prime or large degree. Synthetic phosphoric acid used for phosphate fertilizers results from reaction of coal and phosphorus compounds in the electric furnace. Many of the highly important solvents are derived directly or indirectly from coal, as for example, acetic acid. The coal tar intermediates, prepared from coal tar crudes, are responsible for a large number of dyes, drugs, perfumes, photographic chemicals, synthetic resins and tanning materials. The camphor substitutes used in making pyroxylin, and phenol and cresylic acid used in making plastics such as Bakelite, find their origin in coal and coal tar products. Several of the synthetic resins of greatly increasing importance in the varnish industry are dependent upon coal tar.

The Place of Coal in the Chemical Revolution

The industrial revolution began on or near the coal fields, and coal has continued long to be the most important factor in creating and expanding the great industrial districts of the world. Improvements in the efficient use of coal in the manufacture of power is assuring for coal its continued prime position in competition with water power. And now with the increasing importance of coal in the creation of new chemical products which are substitutes for many products of mine, field and forest, those regions with abundant and readily available coal supplies are in an even more preferred position for industrial dominance than heretofore. Chemistry apparently has more firmly seated King Coal on his throne.

The significance of this situation to foreign trade is apparent. It further emphasizes the differences between the few coal-rich areas of the world and the many and large coal-less areas. The great advances in international trade during the 19th and early 20th centuries were between the coal and non-coal areas—between regions of contrasting resources based on the absence or presence of coal as power and as a chemical reagent of supreme importance especially in the metallurgy of iron. Coal itself, as well as all the products of coal and coal power, was a large constituent of that trade. The new chemistry and the new physics of power still further emphasize coal as supreme both as a chemical factor and as a power factor in industry and seem to assure the continued dominance of the coal regions in industrial progress. And this also, it seems to me, means continued, if not greater, emphasis upon interregional and international trade as a necessary factor in both the scientific and economic development of the world. This trade is to be measured in importance, perhaps, less by its absolute volume but most because of its vital relation to the growth of a more and more scientific and complex industry in a world characterized by a tremendously uneven distribution of resources.

Dehydrating Acetic Acid By Extraction

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ON DEC. 18, 1883—50 yr. ago—almost to the day, Dr. Theodor Goering filed his application which resulted in the German Patent No. 28,064, entitled, "Process for the Production of Concentrated Acetic Acid and Acetates From Dilute Aqueous Solutions by Means of Extraction." This patent and the work it represents are interesting because of the number of people who have since gone to the labor of determining the same thing. It developed the field which has since been investigated by many others, sometimes without knowledge of the earlier work. Indeed, the specification of distillation of such an extracting material as ethyl acetate from dilute acetic acid indicates that Goering was familiar with, or at any rate, accomplished so-called azeotropic distillation many years before Young dehydrated alcohol by distillation in the presence of a third liquid.

A translation of parts of the patent specification is helpful to an understanding of the process of extraction: "Acetic acid is, for a time, mechanically transmitted to another liquid from which it can easily be separated.—The temperature is of little importance.—If, for instance, water containing acetic acid is brought into contact with ethyl acetate, there will be a division of the acid present between the two liquids, depending on their respective volumes.—If an entire absorption of acetic acid is required from the liquid which has to be extracted, the contact must be conducted systematically, that is, a counter flow is arranged between the two liquid layers within the extraction vessels, no matter whether only one or several combined vessels are employed. In this manner a degree of saturation in the extraction solvent will be obtained that corresponds to the original concentration of the aqueous solution of acetic acid; and therefore a smaller amount of the solvent will be necessary. The liquor is exhausted of acetic acid, while dissolving a certain quantity of solvent, which will be recovered by distillation.—In the production of concentrated acetic acid, low boiling esters are employed as extraction solvents. In the distillation which follows, these are removed with moderate diphlegmation, nearly free of acetic acid, while the acid rests as remainder."

Dr. Goering at that early date described the principles and practice of the recovery of acetic as used in several large plants today. He even specified and gave the characteristics of one of the solvents now used. Two further modifications were described: one the subsequent extraction of the acid from the solvent with pure water, thus leaving most of the impurities in the original aqueous phase, and those extracted by the solvent, in the solvent phase. A second modification was the addition of salts to decrease the relative solubility of acid in the solvent, compared to its solubility in water; and of other salts to combine with the water dissolved with the acid by the solvent. The purification method using the solvent substantially as a filter for removing all kinds of liquid and solid impurities has, as far as known, never been used simply for separating foreign materials from aqueous acid, although the purification so obtained by extraction and distillation is of practical importance wherever the method is used. The addition of salts has been mentioned in many subsequent patents, but the advantage so gained is usually more than offset by the complication and cost of recovering the salt for reuse. A modification patented by Ricard and Guinot, U.S.P. No. 1,860,553, and by Dreyfus and Haney, U.S.P. No. 1,696,432 makes use of a second liquid such as a hydrocarbon in a mixture with the solvent. The solubility for water of the solvent layer is thus reduced, and a stronger acid is obtained.

Suida, in U.S.P. No. 1,624,810, Martin, U.S.P. No. 1,717,719, von Belatin, B. P. No. 20,125, and many others have secured patents on modifications of this process with the same or different solvents, while Brewster failed to obtain patent protection in this country on the use of ethyl ether in the same process. Brewster's system has been, and is, used in this country and abroad with ethyl ether or isopropyl ether, depending on the relative costs of the two solvents, and the temperature of the cooling water available. Von Belatin wanted to produce a strong vinegar and preferred the use of ether because it carries through the aromatic flavors associated with vinegar, while leaving the water behind.

Ricard and Guinot, U.S.P. No. 1,860,553, clarify Goering's distillation step and claim the use of lower esters, first as extracting agents, and then as azeotropic withdrawing agents.

Liquid-liquid extraction is a unit operation of chemical engineering, the mechanics of which have not been as well investigated as that of many other unit operations. The prediction of performance is based on physical factors different from those governing calculations for rec-

The second section of a paper on acetic acid dehydration presented before the Roanoke meeting of the American Institute of Chemical Engineers, Dec. 14, 1933. The first section appeared in the December issue of *Chem. & Met.*

tifying column, but the general method of approach is the same as both methods are based on diffusional relationships. Various published and unpublished methods of mathematical analysis which have been suggested depend on simplifying assumptions and involve greater or smaller errors. A large field of theoretical and practical interest is being opened up by the increasing use of liquid-liquid extractors, not only for acetic acid concentrations but in other fields as well.

Liquid-liquid extraction depends on a process of diffusion between the particles of two liquid phases rather than between the particles of a gaseous and a liquid phase as in the case of rectification. In both cases it is necessary to apply mechanical energy to obtain intimate contact between the particles of the two phases; the particles are then usually allowed to separate into the two phases, after which the process is repeated over and over again. In distillation and rectification, the mechanical energy is immediately available at no cost for as many steps or "plates" as desirable by the simple expedient of building up in the still pot a vapor pressure above that of the rest of the system. The vapors are then allowed to perform the work of agitation and mixing which they do with a very high degree of efficiency, on the plates of the column as the vapor phase expands from the higher pressure of the still pot to the lower pressure of the condenser. No such simple and automatic mixing method is available in the case of countercurrent liquid extraction; and, in general, outside mechanical energy has to be supplied to the extracting system in order to break up the liquid masses into small particles, which by diffusion arrive at a state of substantial equilibrium within a short time. In this connection it is interesting to note that while a practical plate in a distillation column never exceeds 60-75 per cent of the efficiency of a "theoretical" plate, that is one in which every particle of vapor comes to equilibrium with every particle of liquid, it is not impossible for a section in an extraction battery to exhibit over 100 per cent of the theoretical (because of the settling action after agitation) and substantial equilibrium in each section can usually be readily obtained by proper designed agitating sections.

Types of Extracting Devices

Various types of extracting devices have been used for systematically contacting in counter flow the solvent layer with the aqueous layer which originally contained all of the acid. These may be roughly classified by types, as: (1) individual cell, (2) mixer-baffle, (3) droplet, or film. The individual cell type is simply an extension of the principle of a series of separatory funnels which are shaken and allowed to settle in which the aqueous acid layer is drained off of No. 1, passed to No. 2, drained off and passed to No. 3, and so on through the higher numbers, gradually becoming weaker in acid. The solvent layer in turn passes from the higher numbered cells through the lower, each time being completely decanted, and becomes progressively stronger in acid, finally discharging from No. 1 as nearly in equilibrium with the aqueous feed as may be practically obtained. In practice, the agitation and decanting steps are always done in separate vessels to prevent the necessity of a periodic operation, as would be obtained with the separatory funnel system.

This method, which is more elementary in principle than anything in distilling practice and compares only to a multiple unit spray gas washer, involves a good deal of tankage, piping, pumping, and mechanical drives. There are many items of equipment in a battery of, say, 15 units, each of which requires an agitator and a decanter as well as a gravity or mechanical flow for one of the layers, and a mechanical flow for the other. In B. P. No. 307,-868 is described one of the most practical arrangements of this mechanism, in which the lighter layer is allowed to flow by gravity from one decanter to the next lower spaced agitator; and the heavier layer is pumped by an air lift to the preceding, higher spaced agitator. Nitrogen or some other inert gas is used in a closed system rather than air because of the corrosive action of air and acetic acid on the usual materials of construction.

Mixer-Baffle Type Extractor

The mixer-baffle type extractor usually takes the form of a column with the aqueous acetic acid fed in at the top, and some solvent of low specific gravity, as ether, at the bottom. The two liquids flow in opposite directions on account of the difference in specific gravity, but are alternately intimately mixed by a series of agitators, and allowed to separate by passing through a space filled with baffles. A representative of this type is that of Coahran (U.S.P. No. 1,845,128). The analogy here is apparent to the usual plate rectifying column, in which the vapors, in small bubbles, agitate the liquid on each plate and, subsequently, lose any entrained liquid in the vapor space between the plates. It is exactly comparable to gas washing or rectifying columns of the Bartlett-Hayward type, in which the division into small particles is made possible by a mechanical rotor or sprayer.

The third general type is the so-called droplet or film-type extractor which depends for its action on the diffusion taking place between a droplet or film of one liquid rising or falling in a mass of another liquid. Usual practice is to fill a tower with two liquid layers: solvent of low specific gravity on top and aqueous acid below. Dilute acid is sprayed into the solvent layer near the top of the tower and the droplets formed are allowed to settle through the solvent layer to coalesce with the aqueous layer maintained at a constant level in the lower part of the column. Similarly, droplets of the solvent are allowed to rise through the lower aqueous layer to the layer of solvent floating on top. The action in exhausting the feed is thus seen to be the combined result of the diffusion of acid through the walls of aqueous droplets into the body of the solvent and of the washing action of the solvent droplets as they rise through the lower aqueous layer. Several forces oppose the perfect action of such an arrangement, the most important is probably the tendency of the droplets to coalesce during settling, and thus increase in size to such an extent that the diffusion process cannot proceed to completion within the time allowed for settling. One method of counteracting this disadvantage is to use a column filled with some form of packing shapes, and to depend on the droplets coalescing into thin films on the surfaces of the packing shapes, bounded on one face by the bulk liquid of the opposite layer. Data are not available for comparing performance of the two modifications, the first of which is analogous to a "spray" distilling column while the second in its action compares directly with the usual packed rectifica-

tion column. The same tendency toward "channelling" is to be noted in this type of extractor as in the packed distilling column.

Extractor columns of the droplet or film type as high as 80 ft. have been used in Europe to give the required degree of counter flow; and others of comparable height are in use in this country. In general, the height must be great to secure efficient operation; and in some cases, this height has been attained by placing two or more sections side by side.

A second main class of extracting methods, the contacting of liquid with superheated vapor, is even more nearly analogous in theory and practice to rectification technique. It consists in passing a superheated mixture of vapors up a rectifying column of the usual bubble-cap type, down which is flowing a solvent for one of the components of the vapor mixture having a sufficiently high boiling point to prevent volatilization. The process is an extraction rather than a rectification and is simply a thorough and countercurrent gas washing operation. Suida (U. S. P. No. 1,624,812, 1,697,738, 1,703,020, and others) developed this process in Europe and in this country primarily for the removal of acetic acid from pyroligneous; with the improvements made in this country a process of widespread use in the wood distillation industry has been developed. The basic principle, that wood tar oils decrease the vapor pressure or "hold back" the acetic acid from an aqueous solution, had long ago been learned by wood distillers in the distillation of wood tars. The disadvantages are a higher equipment and steam cost than the best of the cold extraction methods, and the fact that approximately 80 per cent acid, rather than the anhydrous, is made. Another vapor phase extraction process, Schwaebel and Schleicher (U. S. P. No. 1,766,404) utilizes organic bases for vapor phase extraction.

Still a third type of extraction has been proposed (B. P. No. 308,210), which refrigerates the aqueous solution in the presence of a solvent cooled to about —25 deg. C. The acetic acid is dissolved in the solvent and the water separated mechanically as ice crystals. Solvent is subsequently separated by distillation. This is one of the best of the several refrigeration methods proposed for taking advantage of the unusual freezing properties of mixtures of acetic acid and water.

Cost of Operation

The principal cost of operation of an extractor is mechanical power, that of a distilling column, heat. A distilling column is a very inefficient heat engine; and in those cases where either an extractor or a distillation system using a withdrawing agent may be used, the extractor would have a tremendous advantage in regard to operating cost. In general an extractor cannot be operated without an auxiliary distillation system which doubles the number of steps and the equipment required. Nor can a simple extraction step produce dry acid as the mixture of acetic acid and solvent results in a tremendous increase in the solubility of water in the latter; the subsequent removal of the solvent also leaves an acid containing some water. The extractor is seen to be an efficient tool for cheaply effecting a rough separation of most of the water; but its use is also found to have some limitations, largely in the resulting complication of equipment and processes. In many methods, an extraction step first removes most of the water with one or more added extracting liquids which are subsequently separated from the dissolved aqueous acid; then a second added liquid is introduced and distilled to remove the water as a withdrawing liquid. The ideal arrangement would be the combination in one liquid of good extracting properties for a first step and good withdrawing properties for the second.

The balancing of these various factors to secure the most advantageous system depends on steam costs, equipment costs, quantity and strength of the acid to be handled, and the resulting concentration desired, availability of various solvents both as to cost and patent licenses, cost and type of labor available. Obviously, the more complicated systems would be practical only with production on a very large scale; smaller operations cannot afford the expense of the fixed charges of the more involved processes. From what has been said above in regard to extraction versus distillation in the presence of withdrawing agents, it follows that extraction would not be economical—or possibly even not feasible—with a solution containing only a small quantity of water, and will become highly desirable below some limiting concentration, depending on the magnitude of these various economic effects in each case.

An improved method of extraction utilizing known materials in a more efficient manner has been recently developed which offers considerable advantages now in use.

Expanded Rubber

AN INSULATING material known by the trade name Onazote has unique properties, according to Harry D. Edwards (*Refrigerating Engineering,* December, 1933). It is (1) the lightest solid known; (2) the most perfect insulator against noise; (3) the most resilient of rubber compounds; (4) more moisture-proof than other insulating materials; (5) remarkably high in dielectric strength, (6) the strongest material of its weight; (7) easily molded to any desired shape; (8) vermin-proof, and (9) inexpensive.

The Expanded Rubber Products, Wembly, England, started commercial production in 1929. Onazote is a vulcanized rubber product highly expanded by gas under pressure.

The process requires the making of a dough which is composed of crude or reprocessed rubber, and customary fillers. The dough is partially vulcanized by placing it in a pressure vessel which can be heated externally. Nitrogen gas is admitted until the vessel is filled to a pressure of about 3,000 lb. per sq.in. Pressure vessel and contents are both treated by steam or other suitable means until a pressure of about 4,000 lb. is created.

Nitrogen is driven into pores of the dough and at the same time the expansion of the absorbed nitrogen resulting from the heating causes the dough to expand. In the meanwhile, the application of heat causes a partial vulcanization of dough, so that when it is removed from the pressure vulcanizer it has a consistency of a rubber eraser. Generally the dough is roughly formed to the shape of the desired article before impregnating and vulcanizing. It is then placed in a mold of the desired form and further heated until completely vulcanized.

Operating Pointers

By WILLIAM T. POWERS

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Charging sugar onto the distributing disk of a self-discharging centrifugal

THERE IS little worth-while information in text books on the operation of centrifugal extractors and practically nothing in general circulation concerning the rapid advances made in operating technique in the last few years. A few remarks, therefore, may assist plant executives in delving into the efficiencies of their equipment and its operation. Our subject will be limited to suspended type centrifugals with overhead drive and bottom discharge baskets, as these are almost universally used for filtering and clarifying.

As in other industries, the aim of the centrifugal manufacturer is to improve the operation of his machines, reduce the inefficient steps of the operating cycles, widen the field of application by special designs and refinements, increase the production of individual units and, in short, do everything possible to reduce the cost of centrifuging.

The steps in a centrifugal operating cycle are: acceleration, charging, spinning, braking and discharging. A given slurry requires the application of a certain degree of centrifugal force for a certain time to obtain the greatest extraction of free liquor from the crystals. This definitely sets the spinning time, so any shortening of the whole cycle means shortening the other steps.

Let us use a specific case to demonstrate how these economies are accomplished—a crystal slurry which will drain to a satisfactory degree of dryness after a 1-minute spin at full speed in a 40-in. basket. There are numbers of machines in this type of operation which require 2 or 3 minutes for charging and accelerating, 1 minute at full speed, 1½ or 2 minutes for braking, another 1½ to 3 minutes for unloading with old style plows, or 2½ to 4 minutes if manually unloaded. The total cycle takes 6 to 9 minutes with the old mechanical unloading or 8 to 10 minutes with manual unloading. This means a production of six to ten loads per hour.

This same job can be done by a modern direct-connected 40-in. unit on a schedule of 15 to 20 loads per hour. Time of acceleration and charging may be cut to 1 minute by selecting the proper motor and improving the charging means. Modern brakes stop a basket from full speed in 30 to 45 seconds and new unloaders with positive low-speed motor drive can empty a basket in 30 to 60 seconds. This general reduction also cuts down the "operator-attention time" and even without automatic timer control one man can still operate two machines. Thus, a modern unit will produce about 100 per cent more centrifuged crystals per hour than the old style machine.

Higher Speed With Safety in New Units

It may be said that few products can be properly dried with a 1-minute full-speed spin in a 40-in. basket. This may be true if the top speed is only 850 r.p.m., with the maximum centrifugal force about 400 times gravity. The full speed of an old machine should never exceed the manufacturer's maximum speed rating. Exceeding the speed limit of a centrifugal is not quite as safe as bolting down the safety valve on an old boiler and then "giving it the works." However, modern 40-in. centrifugals are being designed to operate at 1,150 r.p.m., developing centrifugal force about 800 times gravity, and these high-speed units will dry satisfactorily a surprising number of products with only a 1-minute full-speed spin.

To cite a specific case—a certain chemical manufacturer wanted to centrifuge about 5 tons per hour of a common free-draining crystal. Basing estimates on 850 r.p.m. operation, "any old" charging, slow braking and unloading, two 40-in. units were contemplated. However, one 40-in. was installed which was direct connected to a 1,200-r.p.m. motor, had a special mixer and charging lay-out, efficient brake, and proper type of unloader. This unit now turns out a 500-lb. centrifuged load every 3 minutes, thus handling the entire job alone.

Manufacturers used to say "A 40-in. centrifugal takes a 15-hp. motor," and let it go at that. Today they study the contemplated operation and recommend the size and type of motor that will give the greatest over-all efficiency, pointing out to the purchaser that an increase of a hundred dollars or so in initial cost may improve the operation of the centrifugal to a degree that means

for Users of SUSPENDED CENTRIFUGALS

a substantial operating economy. Of course, the development of explosion-proof, totally-inclosed, fan-cooled, and duct-ventilated motors has opened fields formerly closed to direct motor-driven centrifugals.

Modern brakes are air or water cooled, and may be either full mechanical or a combination of mechanical and electrical. They are as much of an improvement as four-wheel air brakes on a modern motor bus are over the old two-wheel mechanical type.

Many users of centrifugals that are being unloaded by hand scoops or shovels may not realize the advantages which unloaders give. These devices have been greatly improved. They have a form of plow fastened to the end of a vertical shaft which may be raised or lowered through a goose-neck assembly secured to the curb cap, and also means for swinging the plow horizontally. When a load has been purged the basket is stopped and the plate valve lifted. (If the basket has no plate valve it can just be slowed to a low unloading speed.) The operator then swings the plow down into the basket and scrapes or digs the load free with the plow, the crystals falling out through the bottom opening while the basket turns slowly. The choice between a "digging" or a "scraping" plow is determined by the nature of the load. Generally, the digger is preferable with large-grained, loosely packed loads, the scraper with finely divided, hard-packed cakes. Unloading in this manner is very rapid as the basket is rotated by the positive power of the motor running at low speed. The time required for emptying a basket may be reduced more than 50 per cent which in some instances might mean one or two more loads per hour from the machine. These dischargers have stops or other devices which prevent the plow from tearing filter cloths or screens and, generally, the life of these filter media is longer with mechanical than with manual unloading. This item alone often pays for the installation of these devices.

So far we have pointed out only how savings may be made by a speeding up of operations already performed by centrifugals. Let us not overlook the fact that slow-speed centrifugal operation frequently offers opportunities for these machines in instances where they are not ordinarily considered practical. There is a large class of finely divided crystalline materials which can be satisfactorily dewatered in a centrifugal which is operated at lower speeds than ordinarily employed. For example, a manufacturer had a large quantity of finely divided calcium sulphate slurry from which a maximum amount of water was to be removed. A series of tests were run which demonstrated that a centrifugal force of 400 times gravity was excessive, the crystals next to the sidewall packing so hard as to impede drainage in the balance of the load and necessitating a long run to obtain any practical degree of dryness. Even then, the entire cake was packed so hard that unloading was a long tedious affair and the entire operation not feasible. However, at a centrifugal force of 275 times gravity the load drained freely and rapidly and the cake was loose enough for easy unloading at the end of the run. The culmination of these tests was an installation of centrifugals with very efficient charging and unloading facilities which can produce as high as 60 tons of centrifuged material per hour with only four operators, two men charging and two unloading.

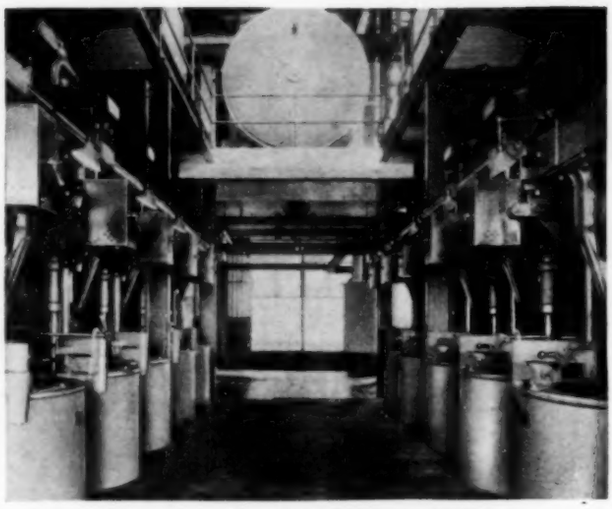
Another type of material which may be satisfactorily centrifuged after careful preliminary testing might be termed the "slow accelerating" type, the name being derived from the method of operation. This class will not drain but will "plug" almost instantly in a centrifugal operated at normal speeds. It may drain to a certain degree at slow speed but will still be too wet at the end of a practical length of run. The answer to this type of problem is frequently found in charging with the basket running just fast enough to have the wall of material vertical, maintaining this speed for a while and then gradually accelerating the basket so as to give a final short squeeze. One vital step in manufacture of a well-known pharmaceutical product could not be accomplished in any practical way except by this method of centrifuging.

High Efficiency Washing Possible in Centrifugals

The inherent characteristics of centrifugal force offer an efficient method of washing which has greater possibilities of development than might be imagined. Each particle of moisture sprayed onto a cake of solids is drawn through the interstices between the individual particles by a force equivalent to many hundred times that of gravity. In general this washing is best accomplished by using a finely divided spray; a solid stream of water from a hose is apt to channel through the load and not accomplish as complete permeation as the fine spray. The spray heads should be adjusted so that the entire surface is covered by the mist. This method was found to give remarkable washing of a metallic salt so fine that a tightly woven filter cloth had to be used in the basket instead of wire screens or perforated metal sheets, and even these cloths had to be washed frequently.

Perhaps the most universal application of centrifugals for washing large volumes of crystals is found in the "wash houses" of sugar refineries. Here every pound of raw sugar which is going to be refined is mixed with an amount of water sufficient only to make the mass flow through the large-diameter mixer spouts into the centrifugal. These centrifugals have self-discharging baskets with bottoms shaped like inverted cones and a large central opening which is not covered with a plate valve as are most flat-bottomed baskets. The charge drops from the mixer spout onto a distributing plate which

is mounted on the machine spindle and, as the basket is rotating during the charging, the sugar flies off and spreads up the basket sidewall. Almost as soon as the basket is full an automatic spray washes the load for a few seconds with a measured amount of water. This water quickly cleans the molasses from the sugar and the basket is stopped. As centrifugal force no longer holds the sugar against the side, the load drops through the bottom opening. This practice has been so perfected that there are 48-in. centrifugals now on the market which handle an 800-lb. load of raw sugar every 2½ minutes. Furthermore, the development of automatic control for washing, length of run, and braking enable one operator to handle four machines—making possible a man-hour output of 40 tons of raw sugar. These machines are loaded in 10-15 seconds, accelerate to over 800 r.p.m. in 35-45 seconds, run at full speed 40-50 seconds and stop in 40-50 seconds. They are generally driven by two-speed motors designed for the service and rated about 40 hp. The brakes are mechanical, air or water cooled, and are sometimes used in conjunction with electrical braking.



White sugar centrifugals suspended from columns supporting mixers

Particle Size Influences Filter Medium

The efficiency of any operation in a filtering type centrifugal, whether at high, medium or slow-speed operation, depends to no little degree on the filtering medium. A combination of a coarse mesh backing screen with either a finely perforated metal sheet or a fine-mesh wire screen is satisfactory for most crystalline loads. The more finely divided materials, however, require the use of a filter cloth which is lapped over the top and bottom edge of a coarse-mesh screen and stitched to it. This is fitted into the basket, allowing a generous over-lapping of the ends, and generally obviates the need of expansion rings as centrifugal force and the pressure of the load securely hold it in place. It also may be removed quickly for washing or replacement with another cloth and screen. This type of filter medium works very well with the calcium sulphate centrifuging referred to above; the cloths plug rather frequently but as they may be changed in a few seconds the machine operation is not interrupted materially.

Very finely divided materials require a bag made so that it covers not only the side wall but also the under side of the top cap and the top of the bottom casting. The vertical seam of this bag is not stitched but has a wide lap, and the side of the bag is stitched to a coarse screen. The upper flap may be fastened to the top cap by spring clips. Every bit of solids properly charged to a machine fitted with this bag is necessarily held in the bag for the possibility of leaks over the edges, as with an ordinary strip of filter cloth, is eliminated.

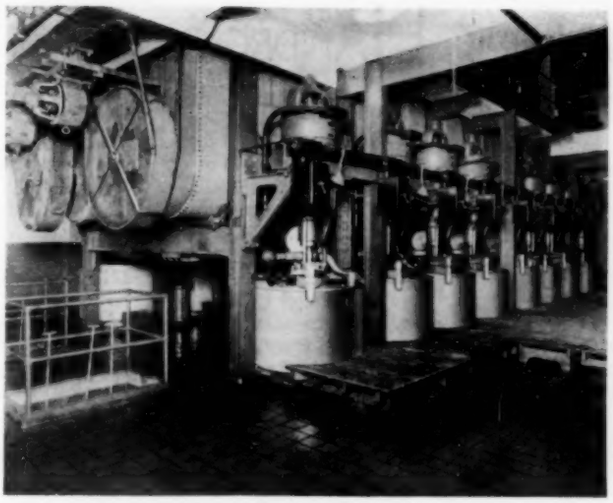
Where cotton filter cloths or bags are used it has been found that a twilled fabric is more satisfactory than a canvas or duck, both of which are apt to shrink so as to close up the spaces between the threads and so impede drainage. A coarse-mesh screen should always be placed between the filter cloth and the basket sheet.

Tiles of siliceous materials molded to fit the inner contours of the basket are also successfully used in certain cases. Joints between the blocks may be caulked with asbestos wicking. This kind of filter has been found particularly satisfactory in centrifuging finely divided anhydrous nickel sulphate.

Some reference has been made to automatic control. It is strange that users of centrifugals have been rather slow to grasp the advantages to be gained by automatic timing when they have gone to great length to minimize the human element in so many other operations. Perhaps it is natural that the best examples of carefully timed operation are found in sugar refineries, where the centrifugal is such an important piece of equipment, all refined sugar having to be spun at least twice. There are wide variations in the extent to which this is carried but generally the control apparatus is started when the operator has filled the basket and throws the switch into full speed. After a sufficient time has elapsed for the purging of most of the liquor, the wash water is automatically turned on, its volume being measured accurately by time. There is another period for spinning out this water and then the power goes off, the brake goes on and, by the time the operator reaches the machine in his regular routine, the basket is stopped and ready for unloading.

Where washing and length of run are left solely to the judgment of the machine operator, it is practically impossible to govern the amount and effectiveness of the washing and to prevent the man from dumping a wet load through carelessness—or intent, if he is pressed for time. This practice naturally results in uneven quality of finished product and varying load on the dryers if they follow the centrifugal. Except for the sugar refineries, the number of plants using automatically controlled centrifugals for extracting liquids from crystalline solids could probably be numbered on the fingers of two hands.

Another development which is just gaining headway, but which promises to become increasingly widespread, is the use of solid or imperforate basket centrifugals for the separation of solids and liquids. Everyone is familiar with the small high-speed centrifuges used for clarifying oils and other liquids containing a very small per cent of solids. They develop very high centrifugal forces and with few exceptions their use is impractical



Sugar refinery installation showing charging spouts and unloaders

only when the volume or per cent of solids in suspension is so high that they must be stopped frequently for cleaning. It is at this point that the suspended-type, imperforate-basket centrifugal can be used in many cases.

The external appearance of these machines is similar to the more common filtering-type units. The basket, however, has a solid instead of a perforated side sheet. This should be fitted with baffles of some kind, not only to direct the flow of the suspension through the basket but, what is more important, to prevent the liquid from surging, which would cause improper clarification or might develop a dangerous basket sway.

The operation is always conducted with the basket running at its maximum rated speed. The suspension to be separated is charged to the bottom of the basket, and flows up the side wall. In its passage centrifugal force deposits the heavy particles against the side. When the space under the basket top ring is filled with the suspension, the liquor at the top has been clarified and, the feed continuing, is decanted over the inner edge of the top cap into the outer case. The operation is continuous until the annular space under the top cap is almost completely filled with solids. The feed is then shut off, the basket stopped, the solid cake removed by an unloader and the machine brought to speed again. This can all be done so rapidly that the feed is interrupted for only a few minutes. How little this unloading interruption can amount to is seen from analyzing a typical case. Assume that a 40-in. unit will clarify 1,000 g.p.h. of a suspension containing 5 per cent solids by volume. The total solid-holding capacity of an average 40-in. basket is about 60 gal. Therefore, the machine in this instance could run continuously for over an hour before it would be necessary to stop and clean it out.

These imperforate centrifugals are suitable for clarifying suspensions, separating unfilterable solids and, in some cases, thickening. Many suspensions now separated slowly in settling tanks, from which the collected solids have to be removed periodically by hand or power shovels, can be more cleanly handled by a centrifugal clarifier at a saving in time and labor. Some slurries discharged from thickeners can be further concentrated in these units.

Centrifugal manufacturers have kept pace with the development of corrosion-resisting alloys and furnish machines in which many of these are used. The factors limiting the use of any metal for centrifugal construction are its yield point (not its ultimate strength), the forms in which it is available (as a basket is made from sheets, bar stock and castings) and its suitability for welding and machining.

The designs of hoods and covers have been so perfected that loading, washing, spinning and unloading can all be performed in an inclosed centrifugal. An increasing number of fume-tight machines are, therefore, being used for spinning loads which give off noxious fumes and for washing materials with volatile liquids, which would otherwise have high evaporation losses or an explosion hazard. The centrifugal dehydration of nitrocotton which is sprayed with alcohol is an example.

Competent Inspection and Repair Assure Safety

Centrifugals must be built with a large factor of safety. As a result their maintenance is low and their life unusually long, barring accidents and damage from corrosives. The fact that they are high-speed machines and should be given careful periodic inspections is apt to be forgotten. It is literally true that there are numbers of centrifugals in operation today which were built 10 or more years ago and have never been given a careful inspection since the day they were erected. Perhaps it is natural, then, that the more of these machines one sees throughout the country working on the widest variety of materials, the more respect one acquires for them. To be trite: truth is always stranger than fiction, as is almost incredibly confirmed by the epic case of a basket returned to a manufacturer for repair which broke into two parts as it was being rolled across the floor! Inquiry developed that it had been running at full speed carrying its usual size of loads up to the moment it was removed from the centrifugal and shipped!

There are no maintenance or mechanical crews or boiler shops capable of doing a dependable, first-class repair job on a centrifugal basket unless the proper apparatus is available for getting both a static and dynamic balance and the workmen have learned through years of careful experience how each step in the job should be performed. Repair work done by the centrifugal builder who has both the proper tools and expert labor costs little if anything more than a "home-made" job and carries with it the knowledge that the finished product is in as good shape as it was the day it was originally built.

It is hoped that plant managers, superintendents and master mechanics who are checking over equipment and processes may find these remarks of some assistance. The information has been gleaned to a great extent from plants where the improvements mentioned are resulting in efficient centrifuging at low cost. The centrifugal manufacturers are devoting more and more time and study to the efficient operation and design of their products in an active effort to make available to their customers information and machines which will assist in solving the problems of economic reconstruction.

THE CHEMICAL ENGINEER'S HANDBOOK

A Symposium of Reviews

CHEMICAL ENGINEERS' HANDBOOK. Prepared by a staff of specialists and edited by *John H. Perry*, Ph.D., Editor-in-Chief, and *W. S. Calcott*, Ch.E., Assistant Editor. Published by McGraw-Hill Book Co., Inc., New York. 2,624 pages. Price, $9.

EDITOR'S NOTE: Almost exactly ten years have elapsed since the first appearance of "The Principles of Chemical Engineering" by Walker, Lewis and McAdams—a text that has probably done more than any other to build in the universities of the world the modern concept of chemical engineering education. Shortly after the publication of this book an advisory committee of more than a dozen educators and practicing engineers under the chairmanship of Dr. H. C. Parmelee outlined plans for a Chemical Engineering Series of texts and reference works, of which nine have been published.

Early in its consideration, the committee recognized the need for a chemical engineering handbook to serve the entire profession in the same effective way in which the mechanical, civil, electrical and mining engineers are served by their engineering handbooks. Dr. John H. Perry of the Grasselli Chemical Co., was persuaded to undertake this tremendous compilation and assisted by Mr. Calcott and a group of sixty contributing specialists, the work has been continuously underway since 1928. More than 150 chemists and engineers have aided with advice and criticism since each of the thirty sections of the handbook were carefully reviewed and checked by independent authorities before publication. That the work of the editor, contributors and critics has been unusually well done is evident from the comments which follow.

In presenting this symposium of sectional reviews *Chem. & Met.* is following the same procedure employed in 1924 in reviewing the first English edition of Walker, Lewis and McAdams, viz., to turn to still another group of specialists to appraise the sections dealing with their chosen fields of activity.

MATHEMATICAL TABLES AND WEIGHTS AND MEASURES (Section I). Compiled by *J. H. Perry*. Pages, 1-138. MATHEMATICS (Section II). By *Raymond W. Dull, T. R. Running*, and *J. H. Perry*. Pages, 139-269.

Reviewed by *Frank L. Hitchcock*,
Professor of Mathematics,
Massachusetts Institute of Technology

BESIDES the usual logarithmic and other tables, the mathematical sections of 269 pages have a number of helpful features not commonly seen. For example, the little one-page table for a horizontal cylindrical tank, giving gallons per inches depth, fills a long-felt want. For very accurate work there is also a 7-place table of segment areas, with heights, and chords. Another unusual table gives 5-place natural logarithms (with handy sub-table for moving decimal point). Very handy, too, is the 4-place table of fractional powers, for instance we read directly $(0.46)^{0.7} = 0.5807$. We can also get $(0.46)^{0.07}$ in two steps without interpolation by taking $(0.46^{0.7})^{0.1}$; thus this table obviates the need of a log-log slide-rule, and is ten times as accurate.

Under weights, measures, etc., the tables of equivalents are unusually full and clear. An article on "Time and its Measurement" by the astronomer Paul Sollenberger gives in three pages just the facts about day and year which we all wish to know accurately. Among the features useful to teachers as well as engineers are a map of standard time belts, accurate values of gas function of latitude and altitude, the Greek alphabet, etc.

The last 130 pages comprise a summary of mathematics up to and including elementary integral calculus. What is given is given clearly and fully, with emphasis on fundamentals, e.g. in *arithmetic* fractions; in *algebra* the solving of equations (including approximate solution of equations of any degree, and essentials of determinants); in *geometry* mensuration and the more important constructions; in *trigonometry* a full collection of working formulas; in *analytic geometry* the more important simple curves.

Under *calculus* "derivative" and "differential" are interpreted geometrically by some exceptionally clear diagrams, with, of course, the usual formulas for differentiation and a short table of integrals. Besides the more frequent series expansions, there are examples on computation with series. Convergence tests are, very properly, treated under *algebra* where, also we find several more expansions and numerical approximations. The commoner "indeterminate forms" are evaluated and some differential equations are solved. Examples are fully worked out on approximate integration and on numerical solution of differential equations.

The most striking part of the work is unquestionably the last 25 pages, consisting of a 9-page article on "Dimensional Analysis" by P. W. Bridgman, which must be read to be appreciated, and 15 pages on "graphs, graph-paper and alignment charts." It is hard to conceive of any chemical engineering reader, whether student, teacher, or engineer, who would fail to find these pages enlightening.

PHYSICAL AND CHEMICAL DATA (Section III). Compiled by *H. R. Arnold, E. T. Lessig, J. H. Perry, E. E. Reid*, and *W. O. Stauffer*. Pages, 271 to 496. INDICATORS, QUALITATIVE ANALYSIS, CATALYSIS, ORGANIC CHEMISTRY (Section IV). By *J. W. Stillman, H. S. Taylor* and *G. D. Graves*. Pages, 497 to 533. PHYSICAL AND CHEMICAL PRINCIPLES (Section V). By *J. C. Elgin* and *J. H. Perry*. Pages, 535 to 651. ADSORPTION (Section XI). By *Charles L. Mantell*. Pages, 1,051 to 1,104.

Reviewed by *Wilder D. Bancroft*
Consulting Chemist and Professor of Physical Chemistry
Cornell University

ALMOST a book in itself, 225 pages are devoted to physical and chemical data. The practical test for each of us is whether we find what we want. The tests I used for this book were tables giving the partial pressures for both components for solutions of ammonia, hydrogen chloride and sulphur dioxide in water.

Indicators, qualitative analysis, catalysis, and organic chemistry are grouped in one section for no reason obvious to this reviewer. Under indicators, stress is laid on the fact that we usually titrate to equivalence of base and acid and not to neutrality. It would be still better to introduce the concept of equivalence end-point instead of neutrality end-point. There is an excellent table of recommended indicators on pp. 500-501, including indicators for such bases as nicotine, morphine, and strychnine.

The outline of qualitative analysis is based on the work of Noyes and Bray, but rearranged by J. W. Stillman of the du Pont company.

The pages on principles and methods of catalytic investigation are written by H. S. Taylor. He says that catalysts activate one or more of the reacting substances; but gives no suggestion as to what activation may be in any given case. In regard to promoters, he says, p. 513: "Recent technical developments indicate that advantages may ensue from employing reaction surfaces into the production of which two or more active constituents may enter. Such mixed materials with special properties are as yet derived wholly empirically and are built up by the slow processes of trial and error from the single constituent surface chosen for its type—reaction efficiency. Experience and intuition are as yet, unfortunately, the main guides in such poly-component studies. At present the problem of the specific efficiency of catalysts is altogether too complex for a fundamental scientific analysis."

One hundred and fifteen pages are given to physical and chemical principles under the headings; general principles; thermochemistry; solutions; chemical equilibrium; reaction rates; thermodynamics; the graphical representation of thermodynamic functions; industrial stoichiometry. The

condensation has been well done, though work done on the system is called positive in the text, p. 592, and negative in the equations.

Under adsorption we read, p. 1,053, that "there are many instances where chemical action on substances in liquids is not sufficiently quantitative to produce the desired result. In such cases it is more economical to add an adsorbent and adsorb the remaining portion than to attempt forcing the reaction nearer completion. Certain types of impurities, such as those of organic origin, because of their complexity and variable constitution, frequently do not respond to chemical treatment for the removal of objectionable color, taste, or odor caused by the presence of these impurities. They may, however, be readily removed by an adsorbent."

Under industrial adsorbents we have fuller's earth, bone char, decolorizing, and gas-adsorbent carbons. There is one paragraph on medicinal carbons and another on alumina; followed by seven pages on silica gel. Many of the data presented will be new and helpful to colloid chemists.

FLOW OF FLUIDS (Section VI). By *T. B. Drew, R. P. Genereaux* and *J. H. Perry*. Pages, 655 to 821. HEAT TRANSMISSION (Section VII). By *W. H. McAdams, A. P. Colburn* and *H. C. Hottel*. Pages, 823 to 910.

Reviewed by
C. E. Kleiber and J. B. Maxwell
Standard Oil Development Co.

"FLOW OF FLUIDS" is here treated with the thoroughness and precision which this important subject deserves in a handbook for chemical engineers. The treatment is sufficiently broad in that fluids in general are considered, but at the same time it is specific with respect to the formulas and recommendations, thus permitting the engineer to cope with any ordinary problem involving fluids in motion.

There are three main divisions—fluid statics, including pressure gages and manometers; flow of fluids, including metering devices, and finally, various tables of data on pipe and fittings. The subject matter and data in the first and third parts are more or less orthodox, but given in greater detail than in the usual handbook. It is the more important second part that distinguishes this chapter from similar chapters in other handbooks. Here general equations are presented for all fluids in contrast to the usual formulas for water, steam and air. Also several pages are devoted to formulas and charts for determining the pressure drop through heat exchangers and packed towers.

Throughout the chapter the more exact theoretical equations are simplified wherever possible, and the limitations and accuracy of the formulas are clearly stated. There is a tendency toward ambiguity in some of the discussions of the equations, which makes it difficult at times to follow the exact meaning intended by the authors. In general, however, the authors are to be commended upon not only the choice of the material but also its presentation.

The section on "Heat Transmission" will prove to be of valuable assistance to the chemical engineer. The subject matter covers conduction, convection and radiation under static conditions of heat flow. The authors have presented an exceptionally well prepared and concise theoretical treatment of the fundamental laws involved. This is further strengthened by the inclusion of, or reference to, many test data. In this last respect the authors have availed themselves of the many investigations completed and reported in recent years which will greatly assist in the practical application of the principles involved. The complete tables of physical data included are desirable in a work of this nature.

The treatment of conduction includes much theoretical information with respect to commercial heat exchange equipment. The data concerning multi-pass units are particularly interesting. Several pages are also devoted to conduction of heat in the unsteady state and suggestions given for the solution of such problems. The second part of this chapter deals with heat transfer by convection. This subject is subdivided conveniently into the various types of transfer usually encountered.

The author of the section on "Radiant Heat Transmission" is to be commended for his treatment of a subject too often slighted. The various cases of radiation between solids and from luminous and non-luminous flames are considered and related to the mechanisms in the combustion chamber of a furnace. With the increasing importance of powdered coal, fuel oil and gas fired furnaces in the industries, the necessity for a recognition of the factors involved in the performance of such units cannot be too strongly stressed.

EVAPORATION (Section VIII). By *W. L. Badger*. Pages, 911 to 956. HUMIDIFICATION, DEHUMIDIFICATION AND COOLING TOWERS (Section IX). By *W. G. Hillen*. Pages, 957 to 992. GAS ABSORPTION (Section X). By *E. M. Baker* and *C. R. Harte, Jr.* Pages, 993 to 1,050. DISTILLATION (Section XII). By *J. S. Carey*. Pages, 1,105 to 1,218. DRYING (Section XIII). By *T. K. Sherwood*. Pages, 1,219 to 1,264.

Reviewed by *T. H. Chilton*
Chemical Department
E. I. du Pont de Nemours & Co., Inc.

"EVAPORATION" by Prof. W. L. Badger, pages 912-956, reflects the practical slant of the author who is well known for his contributions to this field. The engineer who has a problem on evaporation can scarcely fail to find suggestions in this section. The discussion of evaporator types is complete, although one might wish that the sketches, page 922, were on a slightly larger scale. Detailed examples of evaporator calculations are given. The collection of heat transfer coefficients for evaporators is unusually complete, but these have not been interpreted in the light of the important contributions to the subject made within the last 12 months.

"Humidification, Dehumidification and Cooling Towers and Spray Ponds" by W. G. Hillen of the Carrier Company, pages 958-992, covers chiefly the principles and practice of air conditioning from the standpoint of an engineer engaged in this work. The material on cooling towers is largely furnished by one of the manufacturers of this type of equipment. In the discussion of psychrometric charts, neither in this section nor the section on "Drying" has use been made of the volume of data on psychrometry published recently.

"Gas Absorption" by Prof. E. M. Baker of the University of Michigan and Dr. C. R. Harte, Jr., pages 995-1,050, covers this subject more thoroughly than any existing treatment.

"Distillation" by Dr. J. S. Carey of Alco Products, pages 1107-1218, includes an adequate review of the available material with regard to the theoretical and experimental phases of distillation, including some results of the author not heretofore published; the presentation of practical design data from plant scale operations, however, makes one realize how little material is available along this line.

"Drying" by Prof. T. K. Sherwood, pages 1220-1264, is very complete as regards the mechanism of drying of solids, and the examples worked out both in this connection and in connection with the use of psychrometric charts and with drier calculations are commendable. The discussion of driers is confined to the more standard types and the reader will notice some omissions of particular variations. A brief sub-section, pages 1261-1264, treats of the drying of gases.

MIXING OF MATERIALS (Including Gases, Pastes, Plastics and Solids.) (Section XIV). By *Kenneth S. Valentine* and *Gordon MacLean*. Pages, 1,265 to 1,312. CRUSHING, GRINDING, AND PULVERIZING. (Section XVI). By *S. B. Kanowitz*. Pages, 1,555 to 1,640. MATERIALS OF CONSTRUCTION (Section XVIII). By *W. S. Calcott*. Pages, 1,721 to 1,779.

Reviewed by *Lincoln T. Work*
Assistant Professor of Chemical Engineering
Columbia University

"MIXING of Material" by Kenneth S. Valentine and Gordon MacLean of the Turbo-Mixer Corp. gives a broad and well co-ordinated treatment of the field of mixing. Under the Fundamentals are presented the practical objectives of mixing and a detailed analysis of the physical factors involved. Forty different types of devices are discussed under the headings: Flow Mixers, Paddle or Arm Mixers, Propeller Mixers, Turbine Mixers, and Miscellaneous Types. There are alignment charts to aid in computations and there are tables showing the types of mixers adaptable to the different requirements of gases, liquids, and solids, and to the type of ultimate mixture. Costs are analyzed in detail and illustrated by specific examples. In the assembly of diversified information in this field the section on mixing represents an especially valuable contribution.

"Crushing, Grinding, and Pulverizing" by S. B. Kanowitz of the Raymond Brothers Impact Pulverizer Co. presents a description of this type of machinery, and its application in industrial operations. There is a brief discussion of theory dealing primarily with energy considerations. Seventy-six mills of different types and different manufacture are briefly described, and some of these are diagrammatically shown. Tables of performance tests on specific materials are presented for many of these mills. Air separation, mill drying, and closed circuit grinding are described.

Numerous applications to industry are cited; among these are the milling of vegetable products, minerals and ores, fertilizers, cements, carbon products, and chemicals. This section could be materially strengthened by a more extended treatment of theory. Specifically, there should be more consideration of grindability, and more examples of size distribution in the sub-sieve range. While there are some cost data, a fuller comparison of mill types with respect to power, labor, and maintenance charges would be worthwhile. Notwithstanding these comments, the section is a valuable contribution from a mill producer of wide experience.

"Materials of Construction" by W. S. Calcott of E. I. du Pont de Nemours and Co. is presented under the two major groups of metals and non-metals. Recognizing the difficulty in transferring laboratory corrosion tests to plant conditions, the author presents details of the total immersion test as an indication of suitability and discusses briefly the effects of oxygen, electrolysis, velocity of corrosive liquid, local concentration, temperature, and impurities. One portion covers special properties of materials, while another presents an extended list of materials for use in chemical operations classified by chemicals. The greater portion of the Section consists of a tabular presentation of the chemical and physical properties of metals and nonmetals, appearing originally, in *Chem. & Met.* It is a well balanced treatment and furnishes in concise form the data of interest to the chemical engineer.

MEASUREMENT AND CONTROL OF PROCESS VARIABLES (Section XVII). By *T. R. Olive* and *H. L. Young*. Pages, 1,641 to 1,720. HIGH-PRESSURE TECHNIQUE (Section XIX). By *Hood Worthington*. Pages, 1,781 to 1,806.

Reviewed by *R. L. Dodge*
Ammonia Department
E. I. du Pont de Nemours & Co., Inc.

WORTHINGTON'S clear and simple description of a hundred or more important "do's and dont's and how's" of handling highly compressed gases belies the days and nights of confusion, disappointment and uncertainty that investigators have suffered in mastering this field. If the prospective worker in the region of high pressure will take the time to familiarize himself with the experience of the pioneers that has been concisely assembled in this section, he will be repaid the effort.

The section is fully concerned with selection of construction materials, design of apparatus, measurement and control, and safety in high pressure work. These phases unfortunately have consumed more than half the attention of the high pressure chemical engineer of the last twenty years. Thanks to the experience assembled and illustrated in this section of the handbook, the chemical engineer of today who is engaged in the use of high pressures, can arrive quickly at his real objective—the study and commercial application of chemical reaction that can be economically carried out under these conditions.

In spite of the modesty of the presentation, it is apparent that the author has learned at first hand the "tricks of the trade."

Although the authors of the section on control have briefly stated the basic requirements for measurements and control of the usual process variables, this handbook section is primarily and properly devoted to an illustrated survey of the various methods by which instrument manufacturers have applied these basic principles to practical duties. Attention is fittingly and repeatedly called to the necessity for a thorough understanding of the process variables and the tolerances of any control problem before a satisfactory choice of methods and equipment can be made, a point which cannot be over-emphasized. The limitations of each different type of control device are clearly stated.

In the introductory section, *General Considerations*, and the concluding section, *Supervision of Instruments*, costly and discouraging mistakes that have been made in the past by improper use of properly designed instruments are summarized for guidance of the chemical engineer. These sections will repay careful reading even if the detailed discussions of the individual methods and instruments for process control are used only in true handbook fashion as specific problems arise.

Unfortunately for the handbook authors on this subject, chemical industry is now so alive to process control and the competition between instrument manufacturers is so keen and able that today's best device will, by comparison, frequently be only fairly satisfactory tomorrow. However, the user must be in a position to distinguish between unimportant changes in style and real improvement in performance. With the help of frequent revisions in subsequent editions that we may expect from this handbook, the chemical engineer should be able to make this distinction.

FUELS (Section XXI). By *H. A. Curtis, H. M. Weir, W. A. Myers,* and *W. J. Huff*. Pages, 1,897 to 2,007. REFRIGERATION (Section XXIII). By *L. H. Morrison* and *H. C. Duus*. Pages 2,097 to 2,221. ELECTRICITY AND ELECTRICAL ENGINEERING (Section XXIV). By *R. G. Warner* and *F. T. McNamara*. Pages, 2,223 to 2,292. SAFETY AND FIRE PROTECTION (Section XXVIII). By *H. L. Miner, G. H. Miller* and *P. V. Tilden*. Pages, 2,445 to 2,520.

Reviewed by *Crosby Field*
Engineer and Executive
Brooklyn, N. Y.

GROWTH in chemical engineering has been definitely marked by this Handbook which contains such a huge fund of information that it might almost have been called a compendium or brief encyclopedia. The sections under review tend to be most useful in the every-day work of the practicing chemical engineer, or to all those confronted with the daily necessities of design, construction, repair, and operation of chemical plant equipment and accessories. The coverage is very thorough and it should be stated that no executive or responsible engineer in a chemical plant should be without this volume.

The individuality of the large number of authors has apparently been permitted full opportunity, consequently there is a lack of uniformity in presentation which is not always advantageous. For example, the chapter on Solid Fuels is lacking in any appreciable operating cost data, which contrasts with the same data given in the chapter on Liquid Fuels. Again in the chapter on Refrigeration, replete with practical information, a formula for horsepower is given which is much more complicated than the usual formula. In certain cases tables have been included containing items which are not self-obvious and on which more information could well have been given. For example, in a table comparing physical properties of solid carbon dioxide and water ice, figures are given for so-called "refrigerating effect" without an explanation of the peculiar definition of this use. Also, the table on heat content of brines could well have indicated a figure for the heat of solution, or a formula for obtaining it, in order to complete the table.

The excellent chapter on Electrical Engineering has no word on electrical transmission other than intra-plant distribution. The chapter on Refrigeration omits the use of the air flow system in cold storage plants, and in the table on freezing mixtures fails to include a warning that those delightfully low temperatures can be reached only under laboratory conditions.

All these criticisms are on very minor points when the entire scope of the work and the excellence of the presentation is considered. There are many compilations not hitherto brought into one place where they could be used, and such curves as those for the composition and freezing points of solutions, and the tremendous number of tables—many of them new, will be found most useful.

The emphasis given to the need of knowledge of Safety and Fire Protection by engineers in plant operation should be commended, and the 69 pages of this chapter contained more essential information on this important topic than has been found in many a so-called "Safety Handbook." It is quite surprising to note the large amount of new data from the radio field and from other fascinating fields of physics that have become sufficiently practical to warrant their inclusion in the chapter on Electrical Engineering. The bibliography given in each chapter forms not only a technical "Who's Who," but also where to find their best efforts.

ELECTROCHEMISTRY (Section XXV). By *Charles L. Mantell*. Pages, 2,293 to 2,401.

Reviewed by *Colin G. Fink*
Professor of Electrochemistry
Columbia University

DEVELOPMENT of electrochemistry has been so rapid within the last twenty-five years that few of us realize how much the modern industrial structure is dependent upon it.

The author has mastered a difficult task of confining within the one hundred pages, first the principles of electrochemistry, and then the most important details of some sixty odd processes—each one of which might form the subject of an individual treatise. Thus, within recent years, there have appeared detailed monographs of three hundred pages and more on aluminum, calcium carbide, corrosion, chromium plating, etc.

The fundamental principles of electrochemistry, such as the laws of Faraday, are discussed in the first forty pages of the section. Many convenient and valuable tables such as those on electrochemical equivalents, conductivities of salts, electrode potentials, and overvoltages are included in this important introductory part.

In the second part of the section sufficient details are included to give the readers a clear insight into present commercial practice of the electrochemical industries. Illustrations, though necessarily reduced in size, add to the value of the text. Included in this "practical" part are topics not usually available, such as the electrodeposition of rubber, electroplating on aluminum, the Bullard-Dunn electrolytic cleaning process, electrolytic recovery of cadmium, the production of ozone, materials of construction for electrochemical processes, etc.

For the electrochemical engineer at the plant, as well as for the engineer in the allied fields of electrical and mining engineering, and the student at the university, this treatise on electrochemistry will be welcomed as a convenient and concise reference.

ECONOMIC FACTORS IN CHEMICAL PLANT LOCATION (Section XXVI.) By *Chas. W. Cuno.* Pages, 2,403 to 2,412. ACCOUNTING AND COST FINDING. (Section XXVII.) By *George A. Prochazka.* Pages, 2,413 to 2,444.

Reviewed by *Albert E. Marshall*
Consulting Engineer, President
American Institute of Chemical Engineers

THE DAY when the most desirable location for a new chemical plant could be determined solely by studies of the availability of raw materials, labor and shipping facilities has passed, and while these are nevertheless important, Dr. Cuno makes evident the need for carefully surveying a number of other essential factors. The author, basing his conclusions on an extended practice as consultant to the Industrial Bureau of St. Louis, has outlined the economic factors of plant location and production, and has given detailed suggestions which will be helpful to any engineer engaged in a location survey for a new or a branch plant. Very little has been published on the fundamentals of plant location, and Dr. Cuno's material is sufficiently valuable to justify its amplification and extension into book form.

Mr. Prochazka is the author of one of the standard treatises on cost accounting for the chemical industries, and while he has drawn on his book for some of his illustrations of practice, his chapter designed for the engineer rather than the accountant, is a simplified summary of present methods of cost finding. Competition has increased the need for accurate and prompt cost records, and has brought along a new "standard cost" method which the author endorses and compares with the more usual "actual cost" system. Not the least interesting of the nine subdivisions of the chapter are the ones outlining the procedure of analyzing a financial statement, and the tabulation (from Kilduff) of depreciation rates. The author's background in chemical engineering has enabled him to approach accounting through analytic steps, and it has stood him in good stead.

EDITOR'S NOTE: Sections of "The Chemical Engineer's Handbook" dealing with Mechanical Separations, Materials Handling, Power, Reports and Report Writing and Patents will be reviewed in these columns in the March issue of *Chemical & Metallurgical Engineering.*

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from Bureau responsible for its issue.

Methods for Manufacturing Acid-Precipitated Casein from Skim Milk, by Charles S. Trimble and R. W. Bell. Department of Agriculture Circular 279; 5 cents.

Regulations Governing the Sanitary Handling and Control of Hides, Skins, Fleshings, Hide Cuttings, Parings, Glue Stock, Hair, Wool, and Other Animal By-Products, and Hay and Straw Offered for Entry into the U. S. Bureau of Animal Industry Order 341; 5 cents.

Sugarcane for Sirup Production, by E. W. Brandes and others. Department of Agriculture Circular 284; 10 cents.

Synthetic Camphor. U. S. Tariff Commission; mimeographed. Investigation of the relation of synthetic camphor production in the United States to consumption.

Alcoholic Beverages. U. S. Tariff Commission; mimeographed. An important statistical resume covering U. S. production, exports, imports, consumption, Internal Revenue taxes and laws, and comparison of Tariff Acts.

Imports of Distilled Spirits and Wines by Countries, 1910-1914. U. S. Tariff Commission; mimeographed.

Alcohol Codes. Agricultural Adjustment Administration Codes of Fair Competition covering: Distilled Spirits Industry, Code No. 3; Alcoholic Beverages Importing Industry, Code No. 4; Brewing Industry, Code No. 5; Alcoholic Beverage Wholesale Industry, Code No. 6; Distilled Spirits Rectifying Industry, Code No. 7; 5 cents each.

Gauging Manual. Bureau of Industrial Alcohol, unnumbered document; 580 pages, $1.00 (Buckram). Embraces instructions and tables for determining the quantity of distilled spirits by proof and weight, January, 1934.

Paper, Basic Sheet Sizes. Bureau of Standards, Simplified Practice Recommendation R22-33, Second Edition; 5 cents.

A Study of the Removal of Sulphur Dioxide From Library Air, by A. E. Kimberly and Adelaide L. Emley. Bureau of Standards Miscellaneous Publication 142; 5 cents.

Psychrometric Charts, by Donald B. Brooks. Bureau of Standards Miscellaneous Publication 143; 5 cents. Nomographic aid to humidity calculations.

Occupation Hazards and Diagnostic Signs, by L. I. Dublin and R. J. Vane. Bureau of Labor Statistics Bulletin 582; 5 cents. A guide to impairments to be looked for in hazardous occupations. (Revision of Bulletin No. 306).

Wages and Hours of Labor in the Leather Industry, 1932. Bureau of Labor Statistics Bulletin 589; 10 cents.

Whole-Time County Health Officers, 1933. Public Health Service, Reprint No. 1585; 5 cents.

Educational Directory, 1934, Part III. Office of Education, Bulletin No. 1, 1934; 5 cents. Lists colleges and universities, including all institutions of higher education.

Vocational Training for the Pulp and Paper Industry. Federal Board for Vocational Education, Bulletin 168, Trade and Industrial Series No. 49; 20 cents. A job analysis with suggestions on the organization and operation of training programs.

Production Statistics From 1931 Census of Manufactures—printed pamphlets on: Power laundries, drycleaning and redyeing establishments; the clay-products industries, sand-lime brick; manufactured ice, refrigerators and refrigerator cabinets, mechanical refrigerators; the sugar industries; abrasive wheels, stones, paper, and cloth, and related products, minerals and earths, ground or otherwise treated; summary for states, industrial areas, and industries; 5 cents each. No arrangement has been made to print a complete bound volume of this Census; use of these separates may therefore be necessary.

Census of Manufactures, 1929, Volume III, Reports by States. Bureau of the Census, unnumbered document; $1.75 (Buckram), 593 pages. Statistics for industrial areas, counties and cities.

Statistical Abstract of the United States, 1932. Bureau of Foreign and Domestic Commerce, 54th Edition; $1.25 (Buckram), 826 pages. Summary of authoritative statistics showing trends of trade and industry and social progress.

Mineral Statistics, 1932-33. Statistical appendices supplementing Minerals Yearbook, 1932-1933, printed as separates by the Bureau of Mines for: Clay; Natural Gasoline; Slate; Mica; Phosphate Rock; Lime; 5 cents each.

Mineral Production Statistics for 1933—preliminary mimeographed statements from Bureau of Mines on: Copper; masonry, natural, and puzzolan cement; lead; zinc; iron ore; range oil and domestic heating oils.

Solubility and Liberation of Gas from Natural Oil-Gas Solutions, by Ben E. Lindsly. Bureau of Mines Technical Paper 554; 10 cents.

Corrosion of Steel by Gases Containing Traces of Hydrogen Sulphide: Effect of Pressure and Moisture Conditions, by John M. Devine and others. Bureau of Mines, Technical Paper 560; 5 cents.

Limestone—Part II, Dimension Stone, by Oliver Bowles. Bureau of Mines Information Circular 6756; mimeographed.

Milling Methods at the Lead-Zinc Concentrator of the International Smelting Co., Tooele, Utah, by W. J. McKenna. Bureau of Mines Information Circular 6758; mimeographed.

Milling Methods at the Oxide Concentrator of the International Smelting Co., Tooele, Utah. Bureau of Mines Information Circular 6759; mimeographed.

Federal Specifications. New or revised specifications of the Federal Specification Board on: Copper-Silicon-Alloy, Bars, Plates, Rods, Shapes, Sheets, and Strips, QQ-C-591; Cotton-fabric, Woven, Asphalt-Saturated, HH-C-581; Naphthalene, Balls and Flakes, R-N-91; Bleaching-Material (Chlorinating Agents), O-B-441; Aluminum, Plates and Sheets, QQ-A-561; Felt, Coal-Tar-Saturated (for) roofing and waterproofing, HH-F-201; Roof-Coating, Asphalt, Brushing-Consistency, SS-R-451; Felt, Asphalt-Saturated, (for) Flashings, Roofing, and Waterproofing, HH-F-191; Terne-Plate (Long Ternes), QQ-T-191; Borax (Sodium Borate), SS-B-611; Roofing, Asphalt-Prepared, Smooth-Surfaced, SS-R-501.

PLANT NOTEBOOK

STRAIGHT-LINE FLOWMETER FOR PLANT MEASUREMENTS

By Roger H. Newton
Department of Chemical Engineering
Yale University
New Haven, Conn.

IN THIS LABORATORY there has been considerable need for a flowmeter which would indicate small rates of flow with a reasonable accuracy and at the same time be suitable for measuring considerably higher rates of flow. The single orifice type, consisting of an orifice in a horizontal plate, surmounted by a cylinder, in which the head is measured, does not fulfill this requirement, because the rate of flow is proportional to the square root of the head. If the orifice were small enough to give satisfactory readings at low rates of flow, a three- or four-fold increase in the rate of flow would cause the meter to flood.

A flowmeter in which the rate of flow is nearly proportional to the head was desired, and to fulfill this requirement a multiple orifice flowmeter was devised. In this the orifice plate is vertical with holes drilled at different levels, so that, at the higher heads, more orifices come into use. By using a large number of holes, properly spaced, the calibration curve may be made to approach a straight line as nearly as is desired. By plotting the theoretical rate of flow through such a multiple orifice, it was found by trial and error that the proper spacing of the holes (all of the same size) would be 0, 1, 2, 4, 6½.

A sketch of the meter is given in Fig. 1. It is constructed entirely of sheet copper with the joints soldered. The liquid enters coupling *A*, over deflector *B*, into chamber *C*. One wall of this chamber acts as the orifice plate, and has four holes *E*, drilled in it as shown. The level in chamber *C* is measured by a gage glass *D* inserted in standard compression couplings, using steam packing to secure tight joints. For convenience in flushing the connection to the bottom of the chamber is made with a tee, to which a petcock is attached. The top compression coupling nut is closed by a soldered disk, so that it can be opened easily for the replacement of a broken gage glass. The liquid discharges through the orifices into chamber *F* and thence to the outlet coupling *G*. A shallow notch cut in the top of the orifice plate prevents the meter becoming blocked at rates higher than its range. Chambers *C* and *F* are of approximately square cross section.

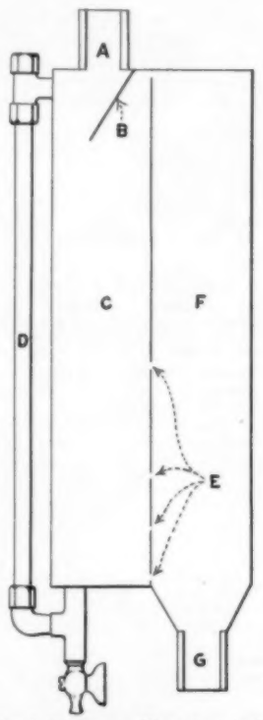


Fig. 1 — Straight-line-calibration indicating flowmeter employing four equal orifices in a vertical plate

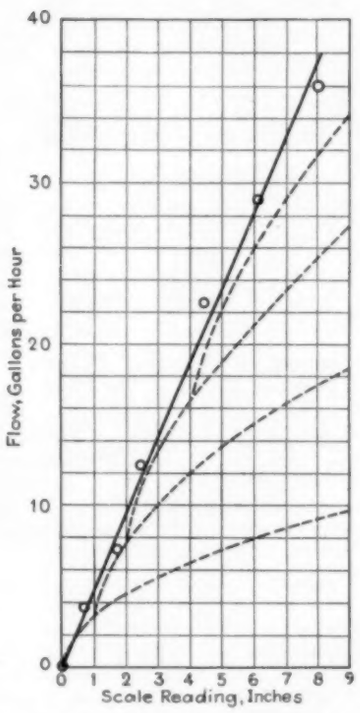


Fig. 2—Calibration curve of meter with four ¼-in. diameter orifices, in comparison with theoretical curve

Two of these meters were made up, one with orifices $\frac{3}{4}$ in. in diameter and the other with ¼-in. diameter orifices. In each, four orifices were used, spaced 0, 1, 2, and 4 in. The length of the scale was 8 in. They have been used to measure the rate of flow of product and of reflux on a small column still for separating butyl alcohol and butyl acetate. The maximum capacity of the meters is 10 and 40 g.p.h., respectively. The calibration curve (solid line) for the one with the larger orifices is given in Fig. 2, together with the theoretical curves, (dashed lines), calculated from the equation; $u^2 = c^2 2g\Delta h$, where the orifice coefficient c is taken as 0.61. It is to be noticed that the actual calibration data fit the straight line somewhat better than the theoretical. The calibration data for the other flowmeter fitted a straight line as well as those for the larger one.

Although the calibration data do not and should not fit a straight line exactly, the error is very small and can be made smaller by the use of more orifices spaced closer together. In the work for which the meters were made up, the error was negligible compared to other variations in the experimental data. It is felt that this flowmeter fills a need for a means of measuring rates of flow which may vary widely, as in the testing and operating of certain pieces of chemical plant equipment, such as stills used for batch operation.

NEW EQUIPMENT

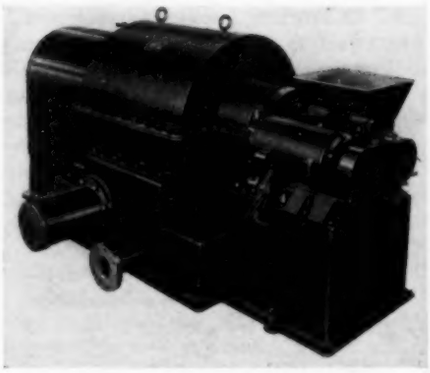
Acidproof Cement

Said to be the only sodium silicate cement which is completely resistant to steam, hot and cold water, hot and cold salt solutions of all strengths and hot and cold acids of all strengths, Penchlor cement, recently introduced by Pen-Chlor Inc., Widener Bldg., Philadelphia, Pa., withstands all strengths and temperatures of acids except hydrofluoric. The material is not resistant to alkaline solutions (except ammonia and bleaching powder solution), but it withstands chlorine, bromine and iodine. The cement is quick-setting and self-hardening, taking an initial set at 70 deg. F. in 20 to 25 min. after mixing the powder with sodium silicate solution. The work is ready for use after three days at this temperature without further treatment.

The compressive strength of the cement is about 2,400 lb. and the tensile strength 350 lb. per sq. in. Its adhesion to brick, stoneware and iron is approximately 100 lb. per sq. in. The material also adheres to steel, lead, wood and glass. Its shrinkage is said to be less than other silicate cements.

Continuous Centrifugal

Claiming for it marked economies in power consumption, installation and materials handling charges, the Bird Machine Co., South Walpole, Mass., has introduced a new continuous centrifugal built in two sizes to give capacities varying, with different materials, from a few hundred to several thousand pounds per hour. Depending on whether the material is filterable or unfilterable, the new machine is supplied with a perforated or imperforate bowl. In any event, the bowl is operated at high speed in a horizontal position, a steady supply of material being fed from the intake hopper into one end. Inside the basket, the material is carried along toward the discharge end by a member rotating at a slightly different speed. The differential gear used to produce this different speed, is said to be of a new high-efficiency type.



New high-speed continuous centrifugal

Among the advantages claimed for the new centrifugal may be mentioned the fact that a thin layer of material, revolving at high speed, is employed, in comparison with the much thicker layer within the basket of the slower-speed batch centrifugal. As the result of this, filtration is said to be much more rapid while the quantity of material within the bowl at any one time is small. Operation is fully automatic so that only occasional inspection is required.

Equipment Briefs

Both industrial dial thermometers and recording thermometers are represented in a new line of instruments introduced by the Jas. P. Marsh Corp., 2073 Southport Ave., Chicago, Ill. Both types are available in either gas filled or vapor tension models, the choice depending on the temperature range desired.

A small unit consisting of a capacitor and resistor, capable of suppressing arcing when added to contactors and line-starters, has been developed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The new device has decreased arcing from as much as five to eight half cycles without the arrestor, to ½ cycle with it.

Robins Conveying Belt Co., 15 Park Row, New York City, has announced a new abrasion-resisting nickel-chromium cast iron known as "Super Manga Iron." Wear tests are stated to have shown two to twelve times longer life than plain chilled iron in numerous applications.

Supplementing two other indicators, the U. C. C. methane detector and combustible gas indicator, a new all-service gas indicator produced by the Linde Air Products Co., New York City, indicates the flammable or explosive character of an atmosphere, shows the presence of poisonous gases and vapors and indicates any deficiency of oxygen. Although designed primarily for the gas industry, its use is indicated in other fields.

For use in industrial screening operations as well as in water and sewage purification, the Filtration Equipment Corp., 350 Madison Ave., New York City, has introduced the new Laughlin self-cleaning bar screen. The surface of the bars is cleaned by sets of scraper blades and carriers supported on a continuously operating traveling chain.

Welds of greater strength and ductility than the parent metal can be produced in cast iron, according to the Lincoln Electric Co., Cleveland, Ohio, through the use of its new "Ferroweld" electrode, designed for use with the company's shielded arc welding process. The rod has a steel core surrounded by a heavy flux coating and operates at about 80 amp. of current.

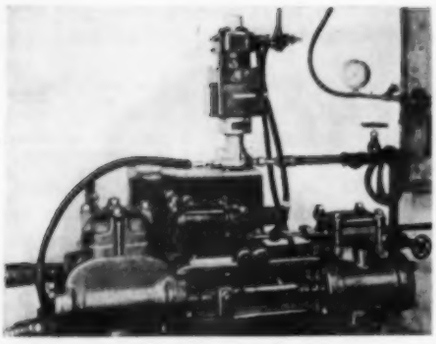
A vertical-action locking ring for attaching the cover is an important feature of a new full-removable-head barrel announced by Wilson & Bennett Mfg. Co., 6532 South Menard Ave., Chicago, Ill. The cover extends over the edge of the barrel and thus prevents the entrance of water or dirt when it is being removed. In the 55-gal. size the barrel is constructed of 18 ga. steel and weighs 54 lbs.

Nickel silver with the graduations etched and blackened is the material employed in the new Tasco slide rule introduced by the Tavella Sales Co., 25 West Broadway, New York City. This is a circular pocket rule about the size of a watch. The nine scales, in addition to the usual ones, include log, C inverted, K, sine and tangent scales.

Three new small heating units recently developed by the General Electric Co., Schenectady, N. Y., include one cast in a heavy block of lead for a power input of 13 watts per square inch of immersed surface; one sheathed in copper with a 1,300 watt rating; and one made entirely of Monel metal, carrying a rating of 12 kw. at 230 volts.

Piston Pump Control

For controlling the stroking rate of standard reciprocating steam pumps in proportion to the flow of another fluid, Proportioneers, Inc., 13 Codding St., Providence, R. I., has introduced a new



"Tret-O-Control" blending asphalt and water emulsion

"Tret-O-Control" which is shown in the accompanying illustration. A meter or other flow-responsive device measures the flow rate of the primary fluid and operates the "Tret-O-Control" gear box, pilot valve and impulse motor, thus dictating the stroking rate of the steam pump. The same device may be used to control the delivery rate of dry chemical feeders.

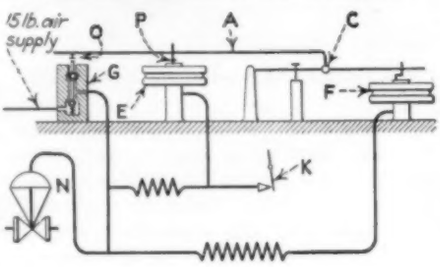
Damped Amplification Controller

C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y., announces that its magnetic-clutch flow controller is now being supplied with a new air-operated control mechanism known as the Tag Damplifier. The new mechanism is said to maintain the setting point precisely, even though this may require at times an almost closed diaphragm valve and at other times an almost wide open valve. Furthermore, it is stated that throttling non-hunting regulation is provided under all conditions.

An understanding of the control system may best be gained by reference to the accompanying sketch. Assume a condition when the pen is directly at the desired rate of flow, which is being correctly maintained by the diaphragm valve. When something occurs causing a tendency toward decreased flow, the pen moves downward and thus requires a greater control-valve opening and lower air pressure on the diaphragm top of the valve. The pen moves flapper *K* toward the nozzle, raising the pressure in detector capsule *E* and bringing lever *A* upward, causing ball valve *G* to decrease air pressure to the diaphragm valve. This decreasing tendency, however, is partially offset, due to the fact that the same reduced air pressure affects detector capsule *E*. Hence only a small diaphragm valve change takes place. But at the same time the damped amplification action of capsule *F* is taking place. As the pressure drops, this deflates capsule *F* and lowers fulcrum *C* of lever *A*, thus moving point *O* upward (with *P* as fulcrum). The effect is slowly to amplify the initial change in position of ball valve *G*.

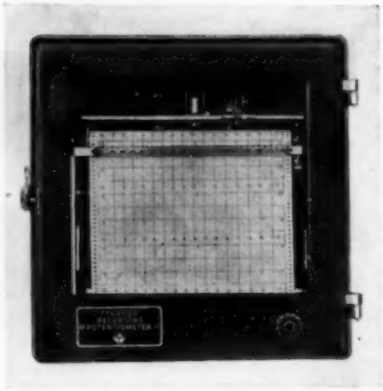
Meanwhile, the gradually decreasing air pressure has been opening diaphragm valve *N* and bringing the recorder pen and flapper *K* back to their original position. Equilibrium is only restored when the recorder pen is exactly at the setting point.

Schematic diagram of Tag Damplifier



Potentiometer Pyrometer

Rapid movement of the printing mechanism from one end of the scale to the other, without the requirement of an extremely fast cycle or rapid motion of the mechanism, is an important feature of the balancing mechanism employed in the new recording potentiometer pyrometer recently announced by the Foxboro Co., Foxboro, Mass. In this mechanism, the sensing fingers, which detect galvanometer deflection, position a friction roller according to the position of the galvanometer pointer.



New potentiometer pyrometer recorder

A V-shaped drive cam then engages and rotates the roller which in turn transmits its straight-line motion to the slide wire contact and pen (or print wheel).

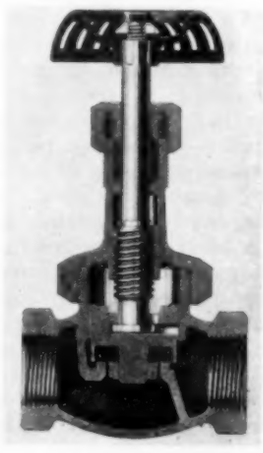
The new recorder uses a 12-in. chart and is furnished to print from one to six temperatures on one chart. Among the features of the instrument may be mentioned automatic cold-junction compensation, mechanical chart re-roll, dust-tight case and accessibility.

This company has also announced a new indicating potentiometer pyrometer for which easy balancing and reading are claimed. By the use of a selector switch, the indicator may be used to give temperature readings from any number of thermocouples.

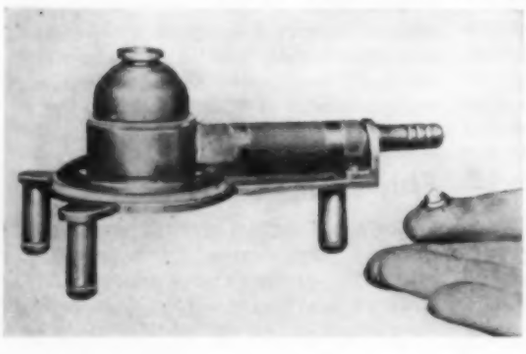
Improved Bronze Valve

For steam pressures to 150 lb. and gas or liquid pressures to 300 lb., the Lunkenheimer Co., Cincinnati, Ohio, has announced a new non-metallic-disk bronze valve. As appears from the cross-section in the accompanying illustration, the valve has an extra deep stuffing box and a heavy rolled bronze stem with long threads which are fully

Cross-section of new non-metallic disk valve



12,000,000 R.P.M. Attained by Tiny Air Motor

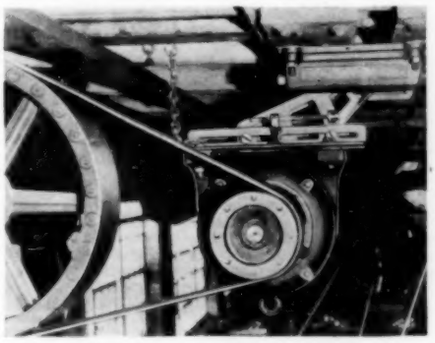


A feature attracting considerable attention at the Chemical Explosion last December was a miniature centrifugal shown by the Sharples Specialty Co., capable of attaining a speed of 20,000 revolutions per second. The device was designed by Dr. J. W. Beams for the company, based on an earlier application of this principle made in France in 1925. The illustration shows the conical fluted rotor together with the stator which serves as the air nozzle. In operation, the rotor rides on a bearing of gas which escapes between the cone and the stator cup at high velocity, floating the rotor free of any mechanical contact.

engaged with the bonnet thread when the valve is closed. The disk holder is of the clip-on type with extra long guards to insure accurate seating. The new valve, known as "N-M-D," is regularly available in several designs, including globe, angle, horizontal, and angle check and quick-operating.

Short Center Drives

Rockwood Mfg. Co., Indianapolis, Ind., has recently added to its standard line of motor-drive bases for short-center belt operation two new bases, one for ceiling drive (illustrated) and the other a vertical-drive motor base for wall mounting. The principle of the Rockwood drive, it will be recalled, is to utilize the weight of the motor, which is pivoted so as to make available the proper component of its weight for belt tension and thus to avoid slip and elim-

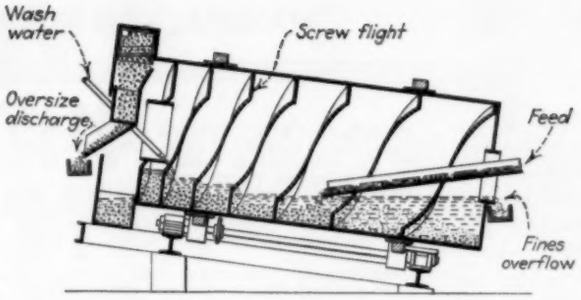


Installation of Rockwood ceiling-drive motor base

inate difficulty with belt stretch under operation. In the ceiling motor base, the principle is carried out much as in the case of the standard drive. In the vertical drive, the force producing the belt tension is derived from coiled springs rather than from the weight of the motor. Otherwise in both principle and operation it is much similar to the standard drive. In both new drives, an adjustment is provided for belt length.

Countercurrent Classifier

For the hydraulic classification of the circulating load of grinding mills and for many washing operations involving solids, the Hardinge Co., York, Pa., has developed a new cylindrical, countercurrent classifier for which ruggedness, simplicity, high efficiency and freedom from wear and mechanical difficulties are claimed. As appears in the accompanying drawing, the cylinder contains a screw flight attached to its inner surface. It is to be noted that both the pitch and height of this flight vary from end to end. Pulp entering at a point near the center comes in contact with wash water cascading over the flights and the solids, depending on their



Cross-section of new countercurrent classifier

size, are carried either toward the oversize or fines discharge. Fines are released from the oversize as the latter is rolled over by the rotation of the drum. The oversize is carried toward the upper end, being "squeezed" by the closer placing of the flights at the discharge. This results in the further elimination of dirty water. The oversize is then lifted by elevating buckets which discharge it by gravity to the feed end of the mill.

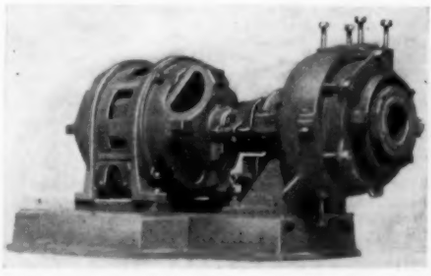
Meanwhile, the fines are carried toward the lower end which serves as a settling basin. The depth of this settling basin is controlled by the diameter of the fines overflow opening. There are five primary adjustments controlling the operating characteristics in the classifier which include: (1) feed; (2) dilution; (3) settling basin depth; (4) variable oversize take-off control; and (5) slope.

In addition to ruggedness, simplicity and high efficiency for the unit, the manufacturers claim the advantages of slow-speed operation, compactness, low wash-water requirements, non-clogging characteristics, negligible repair cost and flexibility. The new classifier is made in sizes ranging from 1 ft. 6 in. x 4 ft. to 10 ft. x 28 ft. Horsepower requirements range from ¼ to 30.

Chemical Stoneware Pump

A new, compact, 1,750-r.p.m. chemical-stoneware pump in which the impeller is carried on the motor shaft so as to make double use of the anti-friction bearings of the motor, has been announced by the U. S. Stoneware Co., 50 Church St., New York City. The pump features a double packing gland, a dual

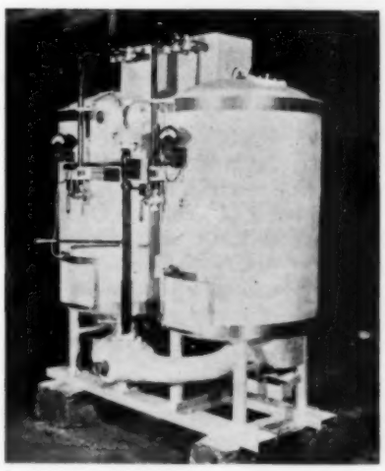
New compact stoneware pump



impeller providing gland relief, perfect balance at 1750 r.p.m., semi-automatic gland adjustment, and temperature compensation to maintain constant gland pressure. All stoneware parts are ground into the protecting armor, all parts are standardized and readily accessible. The overall efficiency is said to be equal to that of similar sized all-metal pumps for water service. Sizes range from 1¼ to 3 in.

Activated Alumina Dryer

"Lectrodryer" is the name of a new drying unit for gases introduced by the Pittsburgh Lectrodryer Corp., Box 1008, Pittsburgh, Pa. The new unit is used for the drying of such gases as natural gas, hydrogen, hydrogen and nitrogen mixtures and manufactured gas. It may also be used for the removal of certain vaporous contents from gas streams in chemical processes. It is stated that dew points of – 50 deg. C. are regularly obtained in commercial



Activated alumina dryer for gases

installations, while lower dew points may be reached if necessary.

The new equipment, which was designed in cooperation with the Aluminum Co. of America to employ activated alumina, consists of a twin tower, one unit of which is in service while the other is being reactivated. The shift from one to the other is accomplished by the movement of a lever and the tower out of service is reactivated by electric heating under automatic temperature control. A water cooling system is provided to cool each section

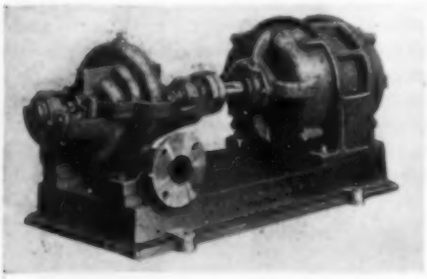
after reactivation. All valves and electrical connections are interlocked to avoid mistakes in cutting towers in and out of service.

Dryers are built for operation at atmospheric pressure or for pressures as high as 90 to 125 lb. or more. Sizes range from a 100-cu.ft. per hour laboratory model to others handling as much as 10,000 cu.ft. of gas per hour.

Double-Suction Pump

Developed for high-speed operation, direct-connected to 3,500 r.p.m. motors and steam turbines, a new line of double-suction, split-case pumps has been announced by the Morris Machine Works, Baldwinsville, N. Y. The design is especially adapted to high-speed operation and to the minimizing of friction and eddy losses. Sizes range from 1½ to 5 in. suction. Deep-groove, heavy-duty precision ball bearings are used for both radial and thrust loads.

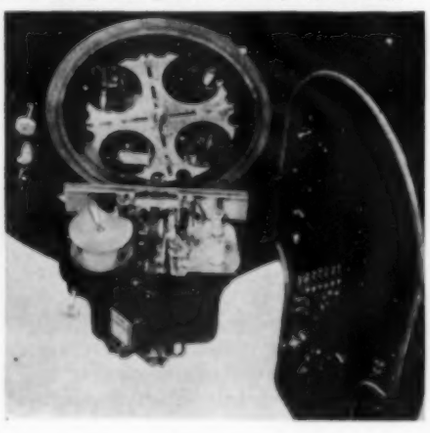
New double-suction centrifugal pump



Printing Scale

Positive weight-control records are provided by the new Toledo Printweigh, figured type, recently announced by the Toledo Scale Co., Toledo, Ohio. This device automatically and mechanically selects and prints the correct weight figure, eliminating all possible weighing errors ordinarily introduced by the human element, according to the manufacturer. It operates in 0.1 second at the touch of a button and may be applied to various dial scales of this company's manufacture.

Toledo printing mechanism, figured type



MANUFACTURERS' LATEST PUBLICATIONS

Bearings. Fafnir Bearing Co., New Britain, Conn.—8-page booklet giving a history of anti-friction bearings from their early beginnings to the present.

Bearings. Timken Roller Bearing Co., Canton, Ohio—258-page revised engineering journal with technical information on types, ratings, etc., on this company's bearings.

Centrifugals. American Tool & Machine Co., 30 Church St., New York City—4-page folder describing a new and improved discharger for centrifugals.

Chlorine. Diamond Alkali Co., Pittsburgh, Pa.—32-page booklet on liquid chlorine, its properties, manufacture, handling, shipment and uses.

Compressors. Worthington Pump & Machinery Corp., Harrison, N. J.—Publications as follows: L-611-S7, 8 pages on single-stage, horizontal compressors; L-612-B1A, 27 pages on feather-valve compressors; D-423-S11A, 4 pages on vertical, triplex power pumps.

Condensers. C. H. Leach Co., 9 Park Place, New York City—Bulletin 100—24 pages on the use and construction of this company's fractional condensers for high temperatures and high pressures.

Cutting. Air Reduction Sales Co., Lincoln Bldg., New York City—Form ADC600—92 pages, profusely illustrated, on equipment for gas cutting of metals.

Dryers. Proctor & Schwartz, Inc., 7th St. & Tabor Road, Philadelphia, Pa.—Bulletin 73—8 pages illustrating eight types of dryer made by this company.

Drying. Aluminum Co. of America, Gulf Bldg., Pittsburgh, Pa.—Form AD86—4 pages on the use of activated alumina for industrial adsorption.

Equipment. Air Preheater Corp., 60 East 42d St., New York City—Bulletin 933—16-page folder describing the Ljungstrom Air Preheater and its applications in power plants and industrial heat recovery.

Equipment. Jeffrey-Traylor Division, Jeffrey Mfg. Co., Columbus, Ohio—Bulletins 579, 581, 582, and 583—Respectively 12, 4, 8 and 4 pages on electric vibrating screens, vibrating conveyors, vibrating feeders, and vibrating coolers and dryers.

Furnaces. W. S. Rockwell Co., 50 Church St., New York City—Catalog 345—Leaflet describing belt-conveyor-type electric furnaces.

Glass. Corning Glass Works, Corning, N. Y.—Bulletin 801—8 pages on Pyrex brand sheets, sight glasses and oven door panels.

Graphite. Acheson Oildag Co., Port Huron, Mich.—Technical Bulletin 11-D—Describes use of colloidal graphite in the manufacture of electrical resistances.

Heating. General Electric Co., Schenectady, N. Y.—Booklet on this company's electric spot and strip heaters.

Hoists. Harnischfeger Corp., 4400 West National Ave., Milwaukee, Wis.—Bulletin RH-1—Illustrates and describes hoists for all purposes.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Leaflet describing accessories for recording instruments including chart inspectors, 9-range current transformers, meter carrying cases, etc.

Instruments. The Foxboro Co., Foxboro, Mass.—Bulletin 187—20 pages on this company's indicating and recording liquid-level gages.

Instruments. Republic Flow Meters Co., 2240 Diversey Parkway, Chicago, Ill.—Catalog 700—24 pages describing this company's recently improved line of cartridge-sealed-element flow meters.

Materials Handling. Federal Pneumatic Systems, Inc., 127 North Dearborn St., Chicago, Ill.—Bulletin 25—Describes this company's laboratory air classifying unit for fine separations.

Materials Handling. The Fuller Co., Catasauqua, Pa.—26-page catalog on this company's pneumatic conveyors, with particular reference to their use in breweries.

Metals and Alloys. Republic Steel Corp., Youngstown, Ohio—Catalog 220-B—64-page book on the properties, production and uses of Toncan iron pipe.

Metals and Alloys. Riverside Metal Co., Riverside, N. J.—Publications as follows: 14 pages on beryllium copper; 32 pages on phosphor bronze; 32 pages on nickel silver; and 4 pages on free-cutting phosphor bronze and nickel silver.

Mixing. Lancaster Iron Works, Lancaster, Pa.—Bulletin 70G—4 pages describing principle and types of this company's Lancirick mixers for use in glass and enamel industries.

Nozzles. Spraco, Inc., 114 Central St., Somerville, Mass.—22 pages on this company's spray nozzles for all industrial purposes; describes construction and gives engineering data.

Piping. Tube-Turns, Inc., 1500 South Shelby St., Louisville, Ky.—Bulletin 51-1—Descriptive information and data on thin-gage copper Tube-Turns for use in distillery and brewery process lines.

Power Transmission. D. O. James Mfg. Co., 1114 West Monroe St., Chicago, Ill.—Leaflet describing this company's flexible couplings.

Power Transmission. Poole Foundry & Machine Co., Woodbury, Baltimore, Md.—Catalog 34—72 pages with engineering data on standard and special flexible couplings made by this company.

Power Transmission. Rockwood Mfg. Co., 1801 English Ave., Indianapolis, Ind.—Folders covering this company's motor drive bases, including standard bases, vertical and ceiling drive bases, bases for small motors and a portable power truck equipped with one of this company's bases.

Protected Metal. American Steel Band Co., Pittsburgh, Pa.—13 pages on "Felt Cote" asbestos-felt-covered steel products for industrial roofs and sidings.

Pumps. The LaBour Co., Elkhart, Ind.—Bulletin 40—16 pages illustrating with engineering data this company's self-priming centrifugal pumps; also a 30-page handbook suggesting performance and test standards for self-priming centrifugal pumps.

Pumps. Roots-Connersville-Wilbraham, Connersville, Ind.—Bulletin 260-B11—4 pages on this company's Type T turbine pumps for high pressures.

Refractories. Harbison Walker Refractories Co., Pittsburgh, Pa.—Two folders describing this company's new product, Harwaco bond, a diaspore-base plastic refractory for bonding refractory brick.

Refrigeration. Carbondale Machine Co., Carbondale, Pa.—Bulletin 1133—8 pages on this company's vertical, duplex ammonia compressors and combined units.

Rubber Preservatives. L. B. McGregor Co., 317 Linden Ave., Long Beach, Calif.—4-page folder describing "Nulife", a newly developed preparation for the preservation of new rubber and the revivification of old.

Rust Prevention. Dearborn Chemical Co., Straus Building, Chicago, Ill.—24 pages on the use of this company's products in the prevention of corrosion in the railroad field; one of a series of publications on rust prevention in industry and transportation.

Screens. J. H. Day Co., Cincinnati, Ohio—Bulletin 361—12 pages on this company's "Ro-Ball" gyrating screens; also mixers.

Screens. Productive Equipment Corp., 7535 South Claremont Ave., Chicago, Ill.—Bulletin 732—20 pages on this company's Jigger vibrating screens with descriptions of new accessories.

Screens. Orville Simpson Co., 1230 Knowlton St., Cincinnati, Ohio—Folder describing new and improved features in this company's Rotex screeners.

Separators. Magnetic Mfg. Co., Milwaukee, Wis.—Bulletin 94—Leaflet describes a new automatic magnetic separator and feed gate, particularly for grains.

Speed Reducers. J. D. Christian Engineers, 514 Brannon St., San Francisco, Calif.—Folder describing this company's "Rite-Lo-Speed" gearing for geared-head motors.

Strainers. The Elliott Co., Jeannette, Pa.—Bulletin A-6—24 pages on twin strainers for pipelines handling water, oil and other fluids.

Thread Handbook. Dardelet Threadlock Corp., 120 Broadway, New York City—Handbook for engineers and designers, containing 220 pages of information on the Dardelet self-locking screw threads; 1933; price, $2.

Traps. Nason Mfg. Co., 71 Fulton St., New York City—20-page catalog on this company's steam traps and specialties.

Welding. Lincoln Electric Co., Cleveland, Ohio—2 pages on electrodes for welding cast iron.

Welding. Metal & Thermit Corp., 120 Broadway, New York City—8 pages on the use of Thermit welding in numerous repairs.

NEWS OF THE INDUSTRY

Chemical code approved by the President on Saturday, Feb. 10. Gas manufacturers at annual meeting in New York discuss problems of refrigerants. Proposal to place import duty on coconut oil brings strong protest from oil, soap, and other industries. T.A.P.P.I. announces lengthy program for spring meeting to be held in New York, Feb. 19-22.

Several Symposia Scheduled For Annual T.A.P.P.I. Meeting

SYMPOSIA on operating, management, and engineering will feature the annual meeting of the Technical Association of the Pulp and Paper Industry which will be held at the Waldorf-Astoria Hotel, New York, Feb. 19-22.

On Tuesday afternoon Feb. 20, the Engineering Division will present a program of particular interest to mill engineers. W. S. Hadaway of the Westinghouse Lamp Co., an authority on illumination will advise on the most up to date method of lighting paper mills and mill offices. F. W. Parkhurst of the Rockwood Manufacturing Co., has been assigned to the meeting by the Leather Belting Association to report the findings made in a comprehensive engineering investigation by all the belting manufacturers of the best methods of transmitting power from motor to machine by means of belts. This study made at a great cost will be available to the paper industry for the first time. J. F. O. Stratton and E. B. Swenson will report on the latest type of heat insulation and will show how aluminum, which is a good conductor of heat, may be used as an insulating material through the use of a new principle called emissivity. The latest electrical engineering developments will be reported by G. M. Reed of the General Electric Co.

On Wednesday morning Feb. 21, F. W. Adams, professor of chemical engineering at the Massachusetts Institute of Technology will report on a survey recently made dealing with the rate of drying newsprint. The use of white water on cylinder machines will be discussed by F. C. Stamm, general superintendent of The Upson Co. Recent surveys on heat utilization in the sulphite and alkaline cooking processes will be discussed by O. L. Berger of the G. D. Jenssen Co. and W. T. Webster of the J. O. Ross Engineering Co.

On Thursday morning Feb. 22, the symposium on Power Supply will bring together national authorities on the subject. The basis of the discussion will be a paper by Walter P. Gavit of the United Engineers and Constructors, Inc. on steam and power in the paper industry. In addition to the outstanding engineers of the paper industry who have been asked to discuss this paper the following engineers of prominence have accepted invitations to be present and to discuss the paper: R. E. Hall of the Hall Laboratories, Louis Elliott, mechanical engineer of the Electric Bond and Share Co., H. B. Lawrence of Henry L. Doherty & Co., and F. S. Clark, consulting engineer of Stone & Webster Engineering Corp. and chairman of the Edison Electrical Institute Committee on Relations and Arrangements between Utilities and the Paper Industry. There will also be a paper on stokers by R. A. Foresman of Westinghouse Electric and Manufacturing Co., which will be discussed by J. S. Bennett, mechanical engineer of the American Engineering Co. A final discussion on Power Plant Reports will be led by A. G. Darling, chairman of the TAPPI Heat and Power Committee. The Engineering Division meetings will be held under the chairmanship of M. H. Teaze of Hardy S. Ferguson & Company, consulting engineers.

On Wednesday afternoon Feb. 21, there will be a review of the most recent developments in the recovery of old papers by new de-inking processes. Sidney D. Wells, technical director of the Combined Locks Paper Co., Combined Locks, Wis., will describe the process recently developed for removing ink from telephone books in the Middle West. This process is revolutionary since it is not customary to de-ink papers containing a large proportion of mechanical wood pulp. Instead of using the orthodox alkaline cooking methods wherein the paper is treated with caustic soda or soda ash solutions, sulphur dioxide is used as a reducing and bleaching agent. To be effective a special ink is employed in printing the papers that are run through the recovery cycle. Stanley Maclaren will describe the new Snyder-Maclaren de-inking process which is used in Eastern paperboard mills. The greatly increased use of paper cartons has led to a demand for cleaner and whiter boards. The de-inked stock resulting from this de-inking process provides a board which is new and attractive to the trade.

Sulphonated Oil Producers Re-Elect Officers

AT A meeting of the Sulphonated Oil Manufacturers Association, held recently at the Hotel New Yorker, New York, C. P. Gulick, president of the National Oil Products Co., was re-elected president of the association. Vice-President C. M. Braham, of the Arkansas Co., Inc., and secretary-treasurer, H. B. Sweatt, also were re-elected. The following were elected directors: C. P. Gulick, V. H. Berman, J. G. Nathanson, C. M. Braham, D. S. Whiteman, H. B. Hooper, H. T. N. Smith, F. C. Scholler, John C. Wolke, C. D. Marlatt, A. E. White, and G. J. Desmond. At a meeting of the board of directors the following executive committee was elected: C. P. Gulick, C. D. Marlatt, V. H. Berman, C. M. Braham, and J. C. Wolke.

Refrigerants Discussed by Gas Manufacturers

THE annual meeting of the Compressed Gas Manufacturers' Association was held in New York Jan. 25-26. A feature of the convention was the luncheon address by Raleigh S. Rife of the Guaranty Co. on the economic outlook.

At the symposium on regulations pertaining to transportation of gases by motor vehicles, G. O. Carter presided. He called on H. M. Mabey of the Mathieson Alkali Works, the head of the transportation committee of the association to start the discussion. Mr. Mabey stated that it is manifestly essential that appropriate regulations should be established and prescribed at the earliest possible time for this most recent form of general transportation service. It is our advice that the Interstate Commerce Commission is now engaged in the formulation of such regulations and that within a few months definite proposals may be made the subject of public hearings.

The chairman then called on R. W. Thomas of the Philgas Co. and S. K. Varnes of E. I. duPont de Nemours & Co. Col. John C. Minor, H. A. Campbell and others took part in the discussion that followed.

A. H. Eustis, president of Virginia Smelting Co., discussed comparative properties and merits of common refrigerants. He showed pressure curves for the substances which have been used as refrigerants; the volumes of the various vapors at different evaporator temperatures expressed in cubic feet per minute which it is necessary to condense in order to absorb 200 B.t.u. per min.; the type of compressor and its bearing on choice of refrigerant; lubrication; permanency. The ease of finding leaks in the system, the cost of the different refrigerants and the hazards connected with the use of the refrigerant were also discussed by the speaker.

Mr. Eustis emphasized his belief that there is no such thing as "the best refrigerant" because he feels that the choice depends entirely on what the refrigerant is to be used for.

The chairman then called on H. D. Edwards of the Carbide & Carbon Chemicals Corp., who spoke on the new refrigerants and their applications. He emphasized the safety factor and stated that regardless of what we may think about the various refrigerants, it is certain that the selection in the future will depend a great deal on the safety features in the applications of the refrigerating machine.

Beverage carbonation was the subject of the address by Dr. W. P. Heath, vice-president of the Coca Cola Co. He discussed the impurities such as mineral matter and chlorine in water which is the largest ingredient in any soft drink. Any water supply may be treated successfully for use in this industry by inexpensive equipment and cost, except those containing excessive amounts of such soluble salts as sodium chloride and sulphates and chloride of lime and magnesia. The expensive process of distillation has to be used with these waters. He also discussed the carbonization of the waters. The two operations necessary for securing proper carbonization are: the forcing of the carbon dioxide into the water, and a transfer of carbonated water to the bottle and crowning without undue loss of carbon dioxide.

James I. Banash, consulting engineer of Chicago and past president of the National Safety Council, discussed the widespread applications of the compressed gas industry. After covering the newer uses for such gases as oxygen, chlorine and the hydrocarbon fuel gases, and the part these gases are playing in our civilization, Banash discussed safety. He stated that it is a duty in which the very existence of the industry is involved for the manufacturers to continue to follow the products in so far as possible to the point of ultimate consumption, while exerting every effort to induce others, as well as themselves, to utilize the products safely.

Industrial Chemistry Exhibit At Newark Museum

AS a new chapter in its series of industrial exhibits, the Newark Museum, Newark, N. J., has in preparation an exhibit for the layman which will be known as "Chemistry Changes Our World: An Exhibit of the New Discoveries for Industry and the Home."

Already more than one hundred national firms have accepted invitation to cooperate in the exhibit, which will open about the middle of March. Among the first to offer cooperation were the E. I. duPont de Nemours & Co., Inc.; Celanese Corp., the Bakelite Corp., the Beetleware Corp., E. R. Squibb and Sons, the Celluloid Corp., Westinghouse Electric Co., Public Service Electric and Gas Co., and the Texas Gulf Sulphur Co. Among those who have offered to act in an advisory capacity to the exhibit are Dr. E. C. Worden of the Worden Laboratories, Prof. William T. Read of Rutgers University, Dr. John H. Schmidt, chairman of the North Jersey Section of the American Chemical Society, and Donald Deskey, decorator, of New York City.

Special educational features of interest to the general public are being scheduled for the duration of the exhibit.

A.S.M.E. Process Industries Division Formed

AFTER several years existence as a committee concerned with the mechanical engineering aspects of the process industries, the process group of the American Society of Mechanical Engineers was given authorization on Jan. 13 to form the Process Industries Division of the society. The new division plans to cooperate with other organizations whose interests its activities overlap. Further than this, it expects to provide for an interchange of information among mechanical engineers in process plants similar to the facilities afforded chemical engineers by the American Institute of Chemical Engineers.

Among the present active committees of the division are those on brewing and distilling, ceramics, cottonseed processing, sugar, paper and pulp, sanitation, heat transfer, disintegration, drying, and unit operations costs. The division has in process the preparation of a much needed code on drying and a research project on cottonseed processing at the University of Tennessee. It is sponsoring a continuing symposium on heat transfer, initiated at the Society's 1933 annual meeting, as well as a lecture course on chemical engineering fundamentals, given in cooperation with the A.I.Ch.E. in New York.

Standards Bureau Continues Simplified Practice Work

ACCORDING to an announcement made Jan. 29, by Dr. Lyman J. Briggs, director of the Bureau of Standards, it has been decided to continue the simplification and commercial standards work at the Bureau in cooperation with the American Standards Association and other organizations and groups concerned with such work. The work has an added importance at this time because of the need for reference to standards of dimensions and quality in the NRA codes for fair competition.

In order to provide maximum benefits for the ultimate consumer, the Bureau, in accepting simplified practice projects, will give priority to those in which the producer groups will signify, in advance, their willingness to identify simplified items in their catalogs and other trade literature.

Similarly, in accepting commercial standards projects, the Bureau will give priority to those in which the producer groups will indicate, in advance, their willingness to employ labels on the product, constituting binding guarantees of compliance with the standards set up in order that the maximum service may be rendered to the consumer.

NEWS FROM WASHINGTON

By PAUL WOOTON

Washington Correspondent of Chem. & Met.

BLANKET complaint by the Federal Trade Commission charging 10 viscose yarn companies with combining in a price-fixing monopoly was instigated by their customers, the knitters. The rayon code does not permit price fixing but NRA did not have a hand in the action taken by the Commission. The case is regarded in Washington, however, as testimony to NRA's recent declaration that the anti-trust laws are not suspended as to coded industries or that "under the protection of a code, industrial groups can fix prices, or carry out other operations in restraint of trade."

The charges made by the Commission date back to an alleged agreement in October, 1931, among the 10 respondent companies to maintain uniform prices of yarn. Pursuant to the agreement, it is alleged that knitters also have been coerced not to sell cloth at less than prices fixed by Viscose, DuPont et al on pain of having the supply of yarn cut off. The Industrial Rayon Corporation is said to have engaged in knitting cloth so that the yarn companies, through Industrial Rayon, might punish price-cutting knitters by underselling them.

The knitting interests which lodged the complaint with the Commission followed through with publicity material asserting that it is impossible for the knitters to obtain an alternative supply of yarn from abroad because the domestic yarn producers, four of which are controlled by foreign interests, are protected by the duty of 45c. a lb.

Chemical and related industries united in objecting to the cotton compensatory tax on multi-wall paper bags at a hearing Jan. 26-27 called by the AAA for reconsideration. The tax of 2.6c. per lb. of paper is equivalent to 23 per cent to 53 per cent of the cost of the bags. Soda ash, pigment, rosin size and other manufacturers protested that the paper bags do not compete with cotton bags as the latter do not protect their products from moisture, leakage and contamination. The Manufacturing Chemists Association is filing a brief with AAA against the tax and the lime, cement, gypsum and silica industries also are opposed.

Calamity forecasters assert that the increased use of fertilizer will wreck government crop curtailment plans. The assumption that 1934 acreage reduction contracts will result in a corresponding reduction in crop yields does not allow for any increased use of fertilizer but enthusiastic estimators who talk about doubling fertilizer use this year cannot prove, even on that basis, more than a 15 per cent to 20 per cent increase in total crops, as only that proportion is produced by fertilizer. The bulk still is produced from the natural fertility of the soil.

There is no evidence that the cotton acreage reduction program increased the use of fertilizer. The program did not, on the other hand, discriminate against normal fertilization, but if the AAA should decide now to limit the size of the crop rather than rely simply on reduction in acreage, the use of fertilizer may be reduced. Limiting the crop to nine million bales would remove the incentive that farmers might have in restricting the planting to 25 million acres.

Surrounding the transportation of inflammables by highway with safeguards similar to those provided for their transportation by rail again is recommended by W. P. Borland, director of the Bureau of Safety, Interstate Commerce Commission. Federal regulation of interstate truck operation and safety requirements now are regarded as necessary by the Commission but there is little prospect that such legislation will be enacted by this Congress.

Anticipating that a court decision or some other contingency may suddenly shut the door to the responsibility assumed by NRA for labor's welfare, Secretary Perkins and other administration patrons of labor have set about making permanent the gains made for labor by the national recovery program and adding further reforms.

Upon the states rather than the federal government they rely for legislation to establish enduring standards of wages and hours, unemployment insurance, old age pensions, industrial health and accident compensation and other measures that, if shouldered by the federal government, may be challenged as unconstitutional.

Concerted action by the states is the prime objective. As more than 40 state legislatures meet in regular session next year and special sessions are likely in others, Miss Perkins and Senator Wagner, of New York, are confident that a comprehensive labor welfare system can be set up within the next 2 years. The mechanics adopted will be left to the individual state but uniformly effective and non-discriminatory measures are hoped for out of state "compacts" whereby naturally affiliated groups will proceed along the same lines, with the cooperation of the Department of Labor in Washington in tackling economic, legal and social problems encountered.

Some legislation by Congress may be desirable either to prod or to help the states carry through their own programs. In this category is the Wagner-Lewis unemployment insurance bill that would assess employers with a federal tax of 2 per cent of their payrolls. This tax would be rebated if and to the extent that employers contribute to unemployment reserves provided by state law but there would be no discrimination as between employers in different states, assuming that the rate paid either as a tax or as a premium is the same.

Only Wisconsin now has an unemployment insurance law. Old age pension systems have been adopted in 27 states but some of them, says Dr. Isador Lubin, chief of the U. S. Bureau of Labor Statistics, are pretty poor. New York and Massachusetts have minimum wage laws. Only 7 states include industrial diseases such as silicosis among industrial accident hazards.

Foreign Trade Bank

A foreign trade bank, financed by the government and ready to assume a portion of the credit risk and all the exchange risk on imports and exports without recourse on the exporter, is in process of formation in Washington. It is being pushed through primarily for trade with Russia, where orders are being held back waiting for credit arrangements here, but the bank will be authorized to finance trade with other countries as well, and on the same general terms. The Russian situation had become so pressing, in certain phases, that action had to be taken promptly, and this was the answer. The money, probably to the extent of something over $300,000,000, will come from RFC funds and from money provided through the Budget plans recently announced, and the bank will not have to wait for special legislation.

Thus the administration prepares to meet its pledge, in the President's inaugural address, that when "first things," that is, the internal situation, has been handled "first," then foreign trade would have its innings.

Meanwhile, there are plans for a private bank under the Edge Act, which allows the formation of a long-term credit bank for foreign trade under the supervision of the Federal Reserve Board, with the right to issue debentures, because Federal Reserve Banks cannot discount domestic bills for long term.

Germany Produces Many Interesting Chemical Developments

FROM OUR BERLIN CORRESPONDENT

MESOTHORIUM, a radium substitute, is now made as a byproduct by the Deutsche Gasglühlicht-Auergesellschaft, in their regular process for treatment of monazite sand. From a charge of 25 kg. of sand 0.0000001 gram of mesothorium is recovered. Thus the foundation of a German radium industry has been laid. In addition to thorium oxide the monazite sand also contains cerium and other rare earths used in the manufacture of filaments and for decolorizing glass. Neodymium is also present and it has lately been used as an addition to glass used for wind shields and goggles for air pilots, to eliminate glare. Mesothorium is of value because it emits gamma rays, which also are found in x-rays. By decomposition of mesothorium, radio-thorium and other decomposition products are formed. The technical production is accomplished by mixing the sand with a small quantity of barium salt and heating it with sulphuric acid. A residuum consisting of barium sulphate, containing mesothorium, quartz, and rare earths is obtained. By further concentration methods this is made to yield a pure mesothorium barium sulphate; no barium sulphate must therefore be lost in the process. By fractional crystallization, repeated up to 100 times, the mesothorium is then separated from the barium salt, to the extent where only a very small quantity of this salt remains. The time required from the dissolving process to the completion of the purification is about three quarters of a year.

Silver may be used as bearing metal in bearings operating without any lubricants, according to investigations by Siemens-Reininger-Veifa, Berlin, especially for anti-cathodes and other revolving pieces used in high-vacuum equipment. They are said to possess very smooth running properties and make it possible to dispense with the undesirable evaporation of lubricants which takes place in high vacuum; furthermore, silver offers the advantage of such a high melting point, compared with normal bearing alloys, that it is possible to heat the evacuated apparatus to red heat or higher, which is often necessary in the production of a high vacuum. The bearing journals are made of hard metals, such as molybdenum or tungsten.

Deutschen Röhrenwerke, Düsseldorf, has brought on the market a new pipe material, under the trade name Dopperlröhre, which consists of two layers, one of which may meet the demands to high corrosion resistance and ductility, while the other possesses great tensile strength. These pipes may easily be bent and possess great economic advantage over materials consisting of a single, expensive alloy.

Although a good grade of common cast iron generally gives satisfactory service in glass molds, great improvements may be obtained by special alloying agents, according to O. Bornhofen, Aachen. Nickel contents up to 3 per cent impart a greater ability to take on a high polish, increase the density and the hardness, and reduce the elongation, with little sacrifice in machining properties. Heat resistance and resistance to scaling are greatly improved by the addition of 0.5-1.0 per cent molybdenum and 0.75-1.5 per cent cerium.

Welding in neutral atmosphere may be done by the use of metal carbonyls, of which only a small quantity is required to give adequate protection from oxidation. One gram of a pentoxide develops 617 c.c. of carbon monoxide at 20 deg. C. In welding iron and ferrous alloys best results are obtained by the use of finely divided iron carbonyl, preferably as a paste mixed with liquid iron carbonyl. Chromium, uranium, and vanadium carbonyls may also be used mixed with liquid iron pentacarbonyl.

Textile chemicals have been used with good success as flotation agents. According to Halbich, Freiberg, Unital HC, containing the sulphonated alcohols as active components with glaubers salt works well as a frother-collector in the flotation of barite. It possesses such high selectivity that only a small quantity of other agents is needed.

Protection of stone surfaces is attained by a method based on the use of silicic acid esters; tetraethyl silicate ester, dissolved in alcohol, to which has been added the desired pigment, may serve for this purpose. As the coating is applied, the silicic acid is set free, and a rapidly drying insoluble film results which is easy to clean and which possesses great resistance to chemical attack and to mechanical wear. By use of proper pigments it may be refractory up to 1,200 deg. C.

High extraction of vanillin from incrusted plant fibers and their decomposition products, such as peat and lignite, and from lignin made from these materials, is obtained, according to Pauly and Feuerstein, Würzburg, by gentle treatment with oxidation agents such as ozone, chromic acid, potassium permanganate, and similar compounds, in acetic acid solution. By hydrolysis with very dilute acids, of the residues thus obtained, still greater quantities of vanillin are produced.

Flax Developments

So many changes have taken place in regard to the power supply of Germany, that a short discussion of this situation may be of interest. First may be considered the addition of alcohol to all motor fuels, specified by law, which, even with the present economic situation, has not lowered the price of these fuels. This measure is now being fought at its source. As is known German agriculture suffers from an oversupply of potatoes, amounting to about 1,000,000 tons a year, from which about 100,000 tons of alcohol is produced. To relieve this situation the land growing potatoes must be used for other purposes, and here flax and oil seeds must first receive consideration, as German imports of wool and cotton and of oils total several hundred million marks annually. German flax growing has shown a drastic decline in later years, but an encouraging result in the efforts to revive it is the success obtained in recent experiments to develop new grades of flax which will give long fiber and high yields of oil. At the same time, a new steeping process has been developed, which works with ozone, and which permits an important reduction in treatment cost. This reduction is about 330 Rm. per ton of fiber (not of flax stalks), an important achievement with the present price of about 1,000 Rm. per ton of fiber.

Much activity is also being displayed in the mineral oil field. In the first place, drilling for oil is being encouraged, frequently by government subsidies; in the second place, like in France, new refineries are being erected for the refining of imported as well as domestic crudes, and finally, production of motor oils and lubricants from lignite and coal tars is growing. Like in France, motors operating on gas from wood distillation plants are also being introduced.

Use of waste gas in the Ruhr District, byproduct gas from coke ovens, of which about 1,000,000,000 cu.m. is available annually, is another important factor. At first it was feared that this gas would furnish much competition with municipal gas works, but this did not prove the case, as about three quarters of it is used by the steel industry.

McCharles Prize Awarded to Ralph William Diamond

ANNOUNCEMENT has been made that the fourth award of the McCharles Prize, instituted by the University of Toronto, has been made to Ralph William Diamond, general manager of the Chemical and Fertilizer Department of the Consolidated Mining & Smelting Co. Ltd., of Canada.

The committee outlined its reasons for selecting Mr. Diamond from among their candidates as follows: First was his contribution to the solution of the concentration problem presented by the Sullivan ore body. Many efforts were made to find some satisfactory metallurgical method which could successfully be applied to these very complex ores. Failure followed failure, until differential flotation was adopted to these ores under Mr. Diamond's direction. This method transformed these deposits of questionable value into what is now one of the greatest lead-zinc mines known to the world.

Secondly, his work in the chemical and fertilizer department of the company, in utilizing the roaster gases from the Trail plant the damaging effect of which in the state of Washington had become an international case. The resulting $10,000,000 fertilizer plant, using power from Kootenays Falls, phosphates from British Columbia and the roaster gases from Trail, produces a high grade ammonium phosphate and sulphate fertilizer for use in the wheat area of the west and generally throughout Canada.

The award in addition to the honor conferred carries a cash value of $1,000. It was established in connection with the bequest of the late Aeneas McCharles of the value of $10,000 and is awarded on the following conditions of the bequest: "To any Canadian from one end of the country to the other, and whether student or not, who invents or discovers any new and improved process for the treatment of Canadian ores or minerals of any kind, after such process has been proved of special merit on a practical scale; or for any important discovery, invention or device by any Canadian that will lessen the dangers, and loss of life in connection with the use of electricity in supplying power and light; or for any marked public distinction achieved by any Canadian in scientific research in any useful practical line."

Japanese Plants to Produce Synthetic Methanol

DEMAND for methanol in Japan has increased to such an extent during the past two years that efforts are now being made to produce it synthetically, according to a report from trade commissioner Donald W. Smith, Tokyo.

Three large companies which are reported to have sufficient financial backing have already constructed plants to produce synthetic methanol. One of these companies is said to be manufacturing the product at the present time and the two remaining concerns are expected to start production during the next few months.

Imports of methanol into Japan during the three-year period, 1929-1931, averaged about 2,200 long tons annually. Imports during 1931, which totalled 2,291 tons, increased to 4,093 tons in 1932. Imports for the ten months of 1933, amounting to 3,624 tons, indicate that the year's imports will equal, if not surpass, the receipts for the preceding year.

New Type Reflecting Surface With Aluminum Base

A NEW type of reflecting surface with an aluminum base was announced at a meeting of the Illuminating Engineering Society, held in Cleveland on Jan. 22. Aluminum treated by the new method has a reflectivity as high as 85 per cent, not far below that of silver. It has the outstanding advantage of not tarnishing in industrial atmospheres, of being weather-resistant, and of being easily cleaned by washing with soap and water. The discovery, made by Dr. R. B. Mason, of the Aluminum Research Laboratories, involves a new type of anodic oxidation, which appears to remove impurities from the surface of the metal.

CALENDAR

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, spring meeting, New York City, week of May 14, 1934.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, spring meeting, New York, Feb. 19-22, 1934.

AMERICAN CHEMICAL SOCIETY, spring meeting, St. Petersburg, Fla., week of March 25, 1934.

ELECTROCHEMICAL SOCIETY, and AMERICAN CERAMIC SOCIETY, joint meeting, Asheville, N. C., April 26-28, 1934.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, June 25-29, 1934.

AMERICAN PETROLEUM INSTITUTE, annual meeting, Dallas, Tex., Nov. 13-15, 1934.

Sodium Sulphate Output in Canada Doubled in 1933

THE sodium sulphate industry of the Province of Saskatchewan, which has been making steady progress over a period of years, assumed real importance during 1933. A report of the Department of Railways, Labor and Industries indicates that the 1933 production of sodium sulphate from Saskatchewan plants will be at least double the output of the preceding year.

John S. Calvert, consul at Regina, reports that Natural Sodium Deposits Limited of Dunkirk, Sask., have doubled their plant capacity and are operating night and day. Horseshoe Lake Mining Co., at Ormiston, Sask., after being closed during the whole of 1932, has been operating to capacity since the middle of August. Sodium Corp. Limited, Alsask, Sask., operated steadily throughout the year and are erecting a new plant which will have an ultimate capacity of approximately four times that of their original plant. Soda Deposits Limited at Fusilier, Sask., has redesigned its plant and expects to operate steadily next year. Metallics and Non-Metallics, Limited, a Toronto company, will erect a sodium sulphate plant to develop the Engebright deposit north of Maple Creek. This deposit is alleged to contain more than 25,000,000 tons of hydrous sodium sulphate.

Oil Cracking Interests Form Permanent Organization

FOR several years the Cracking Development Conference, comprising representatives from leading petroleum companies, has held semi-annual meetings to review technical developments and to consider methods of processing applicable to the oil cracking field. Prior to the meeting held in New York last December whoever acted locally as chairman to arrange for a given meeting also served as chairman of that meeting. At the New York meeting it was decided that a permanent form of organization should be adopted. Wm. F. Moore, of Gasoline Products Co., who presided at the New York meetings, was elected permanent chairman. John T. Ward of The M. W. Kellogg Co., was elected vice-chairman. Mr. Ward also becomes permanent chairman of the Sub-Committee on Research. The headquarters of the Conference will be at the offices of Process Management Co. at 405 Lexington Ave., New York. It is believed that the continuity of function, obtainable through having permanent officers, will prove effective in coordinating the progress, from meeting to meeting, in the subjects discussed. The next meeting will be held at Port Arthur, Tex.

NAMES IN THE NEWS

CHARLES G. GLENN, former chief engineer of Solvay Process Works at Solvay, N. Y., has been named chief engineer of all three plants of Mathieson Alkali Works which is constructing the plant at Lake Charles, La., for manufacture of soda ash and other products.

CHESTER H. JONES, former *Chem. & Met.* editor and manager in Chicago, has taken an executive position with the Richards Chemical Works of Jersey City, N. J.

FREDERICK KING is now employed by the B. F. Goodrich Rubber Co., Akron.

JOHN W. SCHUMACHER, formerly chemist for Acme White Lead & Color Works and later connected with United Color & Pigment Co., has been appointed sales representative for Glyco Products Co., Brooklyn.

ROGER ADAMS, head of the department of chemistry in the University of Illinois, has been elected president of the American Chemical Society for 1935. Charles L. Reese of E. I. du Pont de Nemours & Co. became president of the society on January 1. E. Emmett Reid of Johns Hopkins University, Edward Bartow of the State University of Iowa, and Gustavus J. Esselen, president of the firm bearing his name, were chosen directors.

CHARLES I. PARRISH is employed by the Pacini Laboratories, Chicago.

W. S. EDGAR, for many years with Flood & Conklin and E. I. du Pont de Nemours, has joined the R-B-H Lacquer Base Co., Bound Brook, N. J., as vice-president and technical director.

BURT H. CARROLL, formerly chief of the photographic emulsion laboratory, Bureau of Standards, is now employed in the research laboratory, Eastman Kodak Co., Rochester, N. Y.

LOUIS K. EILERS has been appointed to the staff of Eastman Kodak Co. at Rochester.

LLOYD C. COOLEY has joined Hiram Walker & Sons, of Peoria, Ill. Mr. Cooley has previously been connected with F. J. Stokes Machine Co. and the Swenson Evaporation Co.

F. A. EUSTIS

F. A. EUSTIS, vice-president of the Virginia Smelting Co., has been elected president of the Compressed Gas Manufacturers' Association. Other officers elected are Eugen Becher, vice-president of Metal & Thermite Corp., first vice-president; Dr. W. B. Heath, vice-president of the Coca Cola Co., 2nd vice-president, and F. R. Fetherston, secretary and treasurer.

GEORGE F. KENNEDY recently became associated with the Oxford Paper Co. in the research department at Rumford, Maine. For several years Mr. Kennedy was in the employment of Hercules Powder Co.

THEODORE R. NAFFZIGER has accepted a position with the Bureau of Standards in Washington, D. C. Dr. Naffziger was a research fellow in bacteriology at Iowa State College.

I. M. LEVINE has accepted a position with the Danciger Oil Co. at Tulsa, Okla.

GEORGE SYKES, executive vice-president of the U. S. Industrial Alcohol Co. and assistant to the president, has resigned to become president of the General Wines and Spirits Corp.

RALPH E. HALL, director of Hall Laboratories, Pittsburgh, Pa., has been selected as recipient of the 1933 Pittsburgh Award. This award is made by the section of the American Chemical Society in recognition of his distinguished service to chemistry and humanity, particularly his contributions to the fundamental knowledge of boiler-water reactions.

HARRY L. GILCHRIST, chief of the Chemical Warfare Service from 1929 to 1933, was ordered retired Jan. 31 by President Roosevelt as major general.

WILLIAM NEIL is now with the Virginia Chemical Co. at Norfolk, Va.

J. H. BARTON has been made general manager of National Oil Products Co., Harrison, N. J.

JAMES K. WELSH has retired from H. J. Baker & Bro. The remaining partners are: Henry V. B. Smith, Edward A. Buck, C. D. Rafferty and H. S. McCormick.

ROBERT BOWIE is with the Sylvania Grade Products Corp. at Emporium, Pa.

D. S. MURPH has been appointed to serve as administrative assistant to Charles Brand in the National Fertilizer Association. In June, 1933, Mr. Murph was appointed chief of the cotton processing and marketing section in the Agricultural Adjustment Administration, and resigned this position to go with the association.

WM. F. MOORE of Gasoline Products Co. has been elected permanent chairman of the Cracking Development Conference. John T. Ward of the M. W. Kellogg Co. has been elected vice-chairman. Mr. Ward also becomes permanent chairman of the Sub-Committee on Research.

HENRY C. SHERMAN, professor of chemistry at Columbia University, has been awarded the William H. Nichols Medal. The award goes to Dr. Sherman for achievement in vitamin research, particularly in its quantitative aspects. This research, winning world-wide recognition, has shown that chemistry, through nutrition, may raise the level of positive health and increase the average length of life.

C. S. YORAN is now located at Chicago with the Featheredge Rubber Co.

C. C. SMITH has joined the Potash Co. of America, Carlsbad, N. M., as vice-president and general sales manager with headquarters in Baltimore. Mr. Smith has been connected with the fertilizer industry since 1900 when he became secretary to C. H. MacDowell, president of Armour Fertilizer Works. Since 1927 he has been with the N. V. Potash Export Co.

CLIFFORD COOPER, a former member of the laboratory staff of Standard Oil Co. of Indiana at Whiting, returned recently from Aruba, D. W. I., where he had been employed by Pan American Petroleum Corp. He has joined the Pure Oil Co. and is living in Chicago.

S. M. D. CLAPPER has been elected president of General Refractories Co., succeeding John R. Sproul, who resigned.

KARL KANTZ has joined the Republic Steel Corp. and will specialize in research and field service on enameling sheets. Previously, he was with American Range & Foundry Co., Northwestern Terra Cotta Co. and Abingdon Sanitary Mfg. Co.

SMITH C. BEAN has been transferred from the Whiting, Ind., to the Neodosha, Kan., refinery of the Standard Oil Co. of Indiana, where he is engaged in engineering work.

JAMES LAWRIE has left the A. O. Smith Corp. to join the Schlizt brewing organization. He is in charge of research.

GEORGE SCHULTZE, formerly associated with the Pure Oil Co. in New Jersey, is now assistant to Professor Bodenstein at the University of Berlin.

D. S. BLISS has been appointed commissioner of industrial alcohol to succeed J. M. Doran.

OMAR ADAMS is employed in the engineering department of the refrigeration division of Armour & Co. at Sioux City, Iowa.

OBITUARY

EUGENE SCHAEFER, president of the Maywood Chemical Works, died on Feb. 5 at his home in Englewood, N. J.

WILLIAM EDWARD GIBBS, professor of chemical engineering at University College, London, died on Jan. 18.

T. CHALKLEY PALMER, former president of the Academy of Natural Science of Philadelphia, died on Jan. 31 at his home in that city.

HENRY STEVENS WASHINGTON, internationally known in the field of mineral chemistry, died at his home in Washington on Jan. 7, at the age of 74.

EMIL F. HOCKE died suddenly in China, Dec. 25, where he was engaged in erecting an installation of Vorce cells. Formerly he was with Westvaco Chlorine Products Co. and Niagara Alkali Works.

JOHN M. DEVINE, petroleum engineer connected with the staff of the experimental station of the U. S. Bureau of Mines at Bartlesville, Okla., died Dec. 7. He died in Oklahoma City after a short illness from a throat infection.

ROBERT BRUCE HARKNESS, JR., of the engineering staff of Merrimac Chemical Co., Boston, Mass., died in that city, Dec. 17, after a short illness.

OTTO V. MARTIN, consulting chemical engineer for the Texaco Salt Products Co., died Jan. 12, at Tulsa, Okla. He was 41 years old.

THOMAS F. WEST, superintendent of the paint works of Felton, Sibley & Co., Philadelphia, died Jan. 15 in the Cooper Hospital, Camden, N. J. He had been ill for about a year.

GEORGE W. KENYON, formerly chairman of the board of the General Chemical Co., died Dec. 28 of heart trouble at his home in Brooklyn, N. Y., after two months' illness. He was 84 years of age.

VERNON ROBINS of Louisville, Ky., died Jan. 1 at his home after a long illness. He was 61 years old. Dr. Robins was city chemist at the time of his death early in the last month.

LYMAN C. NEWELL, head of the chemistry department at the Boston University College of Liberal Arts, died Dec. 13 at Brookline, Mass. Dr. Newell was a vice-president of the American Chemical Society.

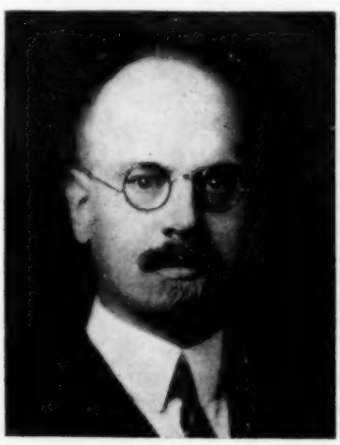
ALFRED W. HOPPENSTEDT, SR., president of the A. W. Hoppenstedt Laboratories, Buffalo, N. Y., died at his home on Jan. 25.

WILLIAM B. HILLS, professor emeritus of chemistry at Harvard Medical School, died Dec. 24 at Montclair, N. J.

S. G. TINSLEY, vice-president of F. W. Berk & Co., died on Dec. 21. He was for many years manager of the St. Louis branch of Armour Fertilizer Works. Following that, he was for several years connected with the Synthetic Nitrogen Products Corp.

WILLIAM ALLAN OSBORN died in St. Luke's Hospital, Cleveland, Ohio. He was 64 years old. After graduation from Yale University in 1893 he became head chemist at the Cleveland Rolling Mills. He retired from that position a few years ago.

E. L. TAGUE, a member of the faculty of the Kansas State College of Agriculture and Applied Science since 1914, was found dead in the chemistry building Jan. 11. He was 60 years of age at the time of his sudden death.



Edward W. Washburn

Fritz Haber

EDWARD W. WASHBURN, chief chemist of the Bureau of Standards, died suddenly Feb. 6 at his home in Washington. Dr. Washburn was 52 years old. Before joining with the bureau in 1926 he had edited the International Critical Tables which were prepared under direction of the National Research Council and had been on the faculties of University of Illinois and Massachusetts Institute of Technology.

FRITZ HABER is dead. He died Feb. 1 at the age of 65 years, while traveling through Basel, Switzerland. Fritz Haber is known chiefly for his success in working out a process which made possible the synthesis of ammonia on a commercial scale and which thus revolutionized industry and agriculture. For this contribution to chemistry he received the Nobel Award for the year 1918.

CHEMICAL ECONOMICS

Production of chemicals continued on a fairly even level throughout January with reports that consumption in some lines was larger than production with the result that consumer stocks were lowered. Actual withdrawals of some important raw materials were reduced because of the unusually large deliveries made in the closing part of last year

ACCORDING to the estimate of the Atlantic States Shippers Advisory Board, the movement of chemicals and explosives for the first quarter of this year will run 14.6 per cent above that for the first quarter of last year. Movement of all commodities during the quarter is estimated at an increase of 11.5 per cent with pulp and paper scheduled for a 3.6 per cent gain; paints, oils, and varnishes, 7.1 per cent; and hides, leather, and tanning materials, 29.6 per cent.

While demand for chemicals suffered somewhat since the first of the year because of the unusually large withdrawals in the latter part of last year, the rate of production in some cases has been advanced over that reported for last December. Reports on activities in the principal consuming industries indicate that consumption of chemicals so far this year has been in excess of production. The reduction in stocks held by consumers greatly enhances the outlook for expansion in production of chemicals during the first half of the present year.

The accompanying table shows the recovery made by some of the chemical-consuming industries last year and gives a fairly accurate idea of their position at the beginning of this year. Developments since the first of the year have been decidedly in favor of an expansion in output of chemicals. The rate of steel operations has been stepped up and automotive manufacturers are assured of a period of large production because of the volume of orders already received. It is estimated that automotive production for the first quarter of this year will surpass the total produced in the first quarter of 1933 by about 50 per cent.

Despite the program looking toward reduction of acreage in cotton and other crops, the fertilizer trade has found a more receptive market for its products since the turn of the year.

Sales of fertilizer tag sales in eight of the principal cotton-growing states during January were the largest recorded for that month since 1930, according to the New York Cotton Exchange. The quantity of fertilizer represented by fertilizer tag sales in these eight states during January totaled 276,000 short tons as compared with 129,000 in the corresponding month a year ago, 92,000 two years ago, and 229,000 three years ago.

A Census Bureau report states that entering 1933 at a level 40 per cent below that of 1931 and 25 per cent below that of 1932, the paint, varnish and lacquer industry, which reached the 1932 level last May, in November practically succeeded in reaching its 1931 sales status. With some reports placing gain in building operations at double that of last year, with automobile schedules definitely on a higher level the prospects for the paint trade are more favorable than has been the case in at least four years.

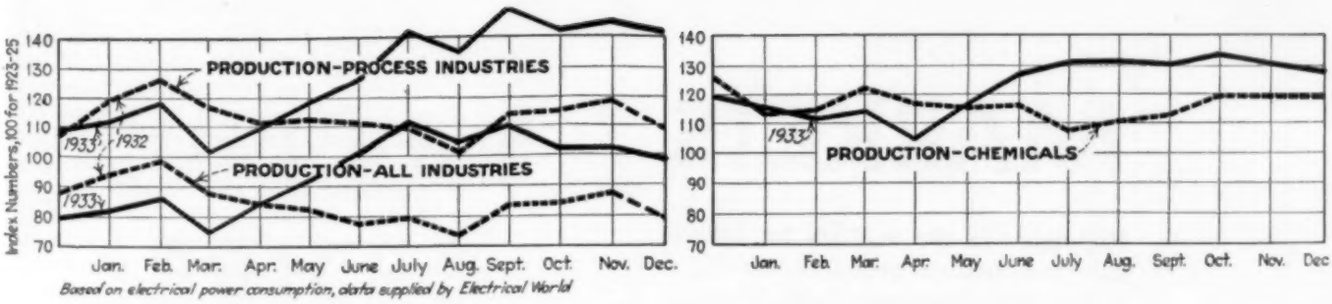
Weather conditions have worked in favor of larger sales of products used in the anti-freeze trade and alcohol manufacturers also were aided by an amendment, approved Dec. 29, to the marketing agreement for the distilling industry by which alcohol made from materials other than domestic cereal grains was authorized to be released for the manufacture of distilled spirits.

Sales of soap, which fell off materially in October and November, picked up in December and leading factors reported that January showed an increase of about 10 per cent over the preceding year. The proposal to place an import tax on coconut oil, however, has created a feeling of uncertainty about future operations.

Production of rayon in 1933 is now placed at 207,578,000 lb. which is an all-time record for the domestic industry. Plant capacities for 1934 are higher than they were a year ago this time. Consuming demand has been up to expectations and the industry for the near future, at least, seems destined to hold above the level reached last year.

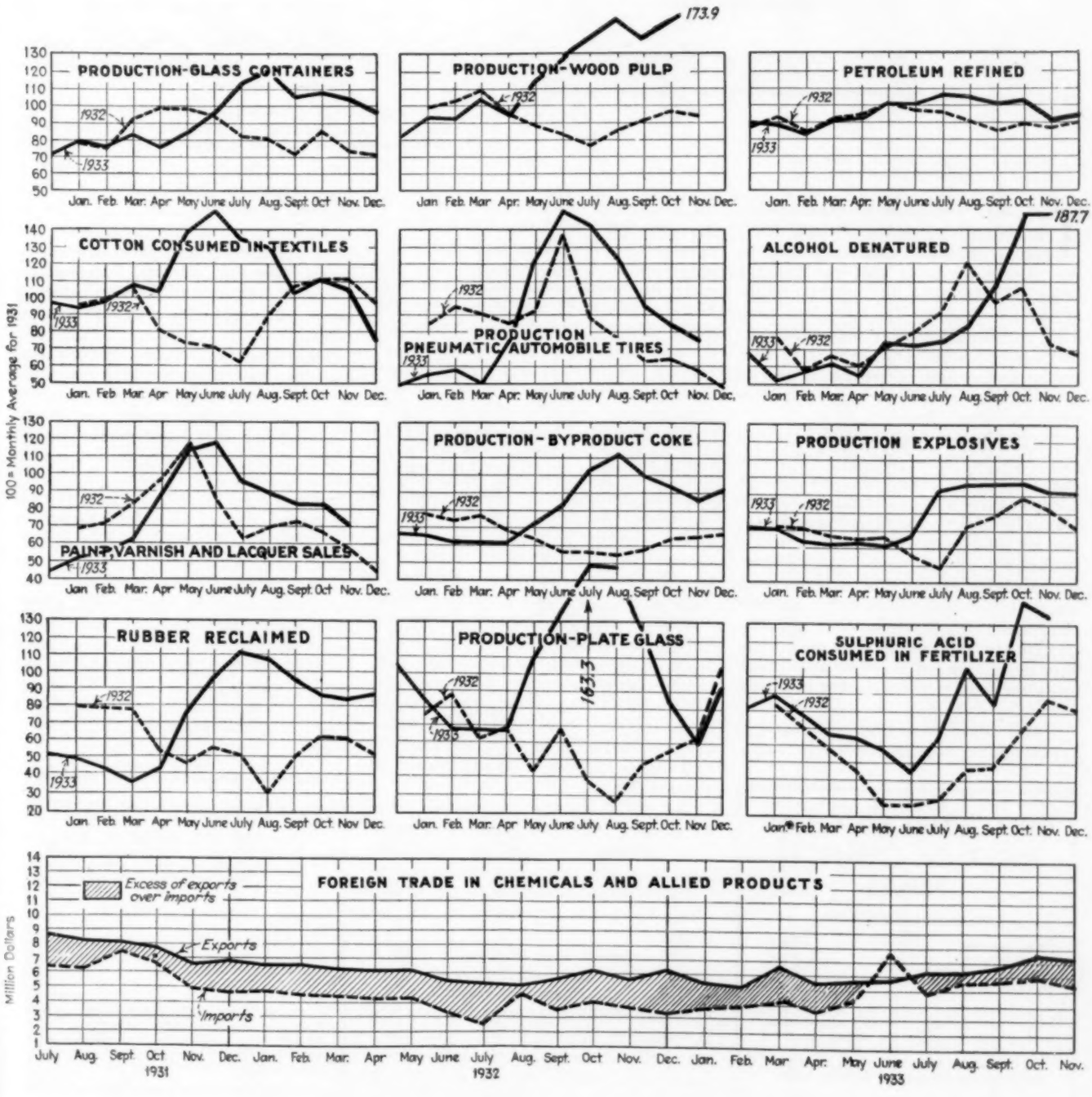
Production and Consumption Data for Important Chemical-Consuming Industries

	First Quarter		Second Quarter		Third Quarter		Fourth Quarter		Year	
	1933	1932	1933	1932	1933	1932	1933	1932	1933	1932
Automobiles, 1,000	355	356	652	516	666	284	286	215	1,959	1,371
Byproduct coke, 1,000 tons	5,090	6,186	5,818	5,163	8,432	4,541	7,382	5,277	26,722	21,167
Cottonseed oil, crude, 1,000 lb	386,545	523,425	209,834	221,967	282,077	249,018	519,500	578,502	1,397,956	1,572,912
Linseed oil, 1,000 lb	79,595	99,783	79,035	65,764	113,413	68,503	133,906	90,987	405,949	325,037
Glass containers, 1,000 gr	4,925	5,040	5,268	5,999	6,972	4,799	6,357	4,720	23,522	20,558
Plate Glass, 1,000 sq.ft	16,770	17,101	23,125	13,549	32,942	8,259	15,078	13,313	87,915	52,222
Paint, varnish, and lacquer, sales, $1,000	36,520	51,255	73,098	67,230	61,809	47,268	.....	38,979	.....	204,732
Petroleum refined, 1,000 bbl	195,119	201,031	217,781	218,127	233,992	202,639	214,362	198,200	861,254	819,997
Pyroxylin spread, 1,000 lb	6,828	7,078	11,409	6,116	10,800	5,836	7,205	5,933	36,242	24,963
Rosin, wood, bbl	83,368	69,389	91,134	86,523	127,207	92,372	128,451	93,660	430,160	341,944
Turpentine, wood, bbl	13,405	11,076	14,373	14,393	19,937	14,759	20,725	15,726	68,440	55,954
Rubber consumed, tons	54,454	79,138	106,256	86,725	113,804	67,284	.....	55,125	.....	288,272
Rubber reclaimed, tons	12,903	24,270	22,160	15,676	32,140	13,290	26,383	17,835	93,586	71,071
Steel barrels, 1,000	935	1,180	1,439	1,533	1,555	1,111	1,933	1,096	5,862	4,920
Sulphuric acid, produced in fertilizer trade, tons	293,771	312,150	241,035	156,036	364,449	164,890	.....	319,505	.....	952,581
Cotton consumed, 1,000 bales	1,406	1,375	1,788	1,021	1,689	1,175	1,327	1,446	6,210	5,017
Silk consumed, bales	117,803	151,463	142,688	106,168	118,634	157,981	90,302	138,206	469,427	553,818
Wool consumed, 1,000 lb	93,731	98,063	134,287	55,406	163,538	114,135	128,073	117,918	519,629	385,522



Based on electrical power consumption, data supplied by Electrical World

TRENDS OF PRODUCTION AND CONSUMPTION



FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS
Excess of exports over imports
Exports
Imports
Million Dollars
July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov.
1931
1932
1933

MARKETS

Highlights in the markets for chemicals and related products include a rising price tendency, large contract withdrawals, tariff proposals to make oilseeds and vegetable oils subject to import duty, details for Chilean nitrate and iodine trade, and possibility of German tariff to reduce importations of carbon black

THE FACT that price considerations influenced consumers to take delivery of chemicals in a large way in the closing weeks of last year had the effect of putting down contract withdrawals in January. Consumption, however, is reported to have been sufficiently large to absorb a large part of consumer stocks and at present deliveries of important chemicals are going forward in large volume.

Establishment of higher contract prices in the latter part of 1933 meant that the market entered the new year on a higher price plane and not only has this higher level been maintained but in the case of some materials there has been a tendency to elevate prices. Basic chemicals such as alkalis and mineral acids may be expected to hold a steady position over the first half of the year but salts depending on a metal base will probably move upward in price as the primary markets become subject to higher producing costs.

Naval stores have been prominent in recent trading because of steadily mounting prices for rosin and turpentine. It has been announced that the marketing agreement will be signed on Feb. 19. The agreement received tentative approval early in January and its salient provisions call for control of marketing by establishing quotas for producers. A control committee will preserve an equitable balance between supply and demand and the market will thus be free from competitive influences.

The only alterations proposed at the public hearing of the code of fair practice for the quicksilver industry, held in Washington, Feb. 2, 1934, related to the labor provisions and publicity on price schedules. W. R. Moorehead, chairman of the executive committee of the National Quicksilver Producers' Association, presented the code without comment. W. A. Janssen, deputy administrator, presided.

Dr. J. S. Gould, labor adviser, suggested that the proposed differential for the South on wage rates was too great. The minimum wage rates would, under the proposed code, be 42½c. an hour, except in the South, where it would be fixed at 30c.

W. H. Edmonds, representing the Consumers' Advisory Board, asked that price schedules be open for public inspection. The code, as submitted, provides for the distribution of the schedules among the "members of the industry."

The hearing was adjourned subject to call at any time within 48 hours.

One of the most important developments of the month was found in the fact that the Ways and Means Committee of the House had approved the placing of a 5c. per lb. duty on coconut oil, including oil originating in the Philippine Islands. This proposal met with strong opposition at a hearing held last December, but the committee has now passed that feature of the revenue bill and refused to accept a counter proposal that an exception be made in the case of coconut oil for industrial use. Should this be enacted into law it would be detrimental to the interests of domestic industries, particularly to soap makers.

German Carbon Black Duty

A report from our consul at Frankfort-on-Main states that referring to previous announcement of the establishment of German lamp black cartel which became effective Jan. 1, it was agreed to operate the cartel for one year and unless cancelled to continue operation for another year. The new cartel provides for production quotas for the seven producing concerns comprising its membership. Its main function will be the improvement of market conditions, the removal of the ruinous competition prevailing on the German market and the elevation of prices to levels permitting profits to manufacturers. One of the first acts of the new cartel has been to urge the establishment of a higher import duty upon foreign carbon black to curb the large volume of imports, thus enabling domestic producers of lamp black to secure a larger share of the German trade.

Reorganization of the Chilean nitrate industry has taken the form of a law which creates a monopoly of exportation and trade in nitrate and iodine. This monopoly is transferred by the State to a legal entity known as the Chilean Nitrate and Iodine Sales Corp. The new corporation takes over the sale of new production and of all stocks held in Chile and abroad as of July 1, 1933. The corporation must purchase from producers who become members of the agreement and the latter must abstain from exporting and from effecting any commercial operations. Sales quotas will be allotted the participating producers with a distribution of profits calculated to amortize present indebtedness and to furnish capital for plant modernization.

CHEM. & MET. WEIGHTED INDEX OF CHEMICAL PRICES

Base = 100 for 1927

This month	**88.37**
Last month	87.86
February, 1933	84.54
February, 1932	85.70

Withdrawals against contracts were at prices higher than those which prevailed in the latter part of last year. The spot market was steady with very few fluctuations. Naval stores advanced rather sharply.

CHEM. & MET. WEIGHTED INDEX OF PRICES FOR OILS AND FATS

Base = 100 for 1927

This month	**54.32**
Last month	51.38
February, 1933	41.70
February, 1932	47.47

Crude cottonseed oil sold at higher levels and with few exceptions the trend was upward throughout the entire market with animal fats following the general tendency.

CURRENT PRICES

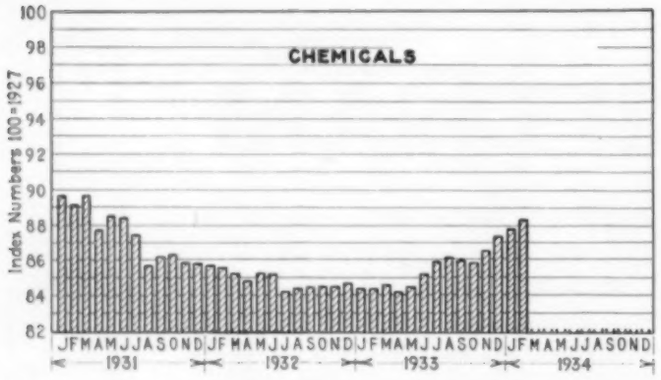
The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Feb. 12.

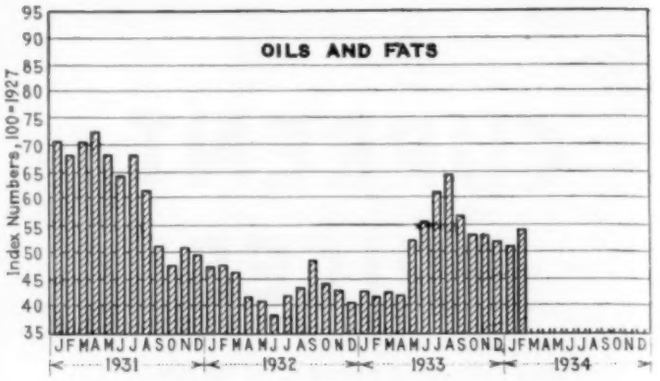
Industrial Chemicals

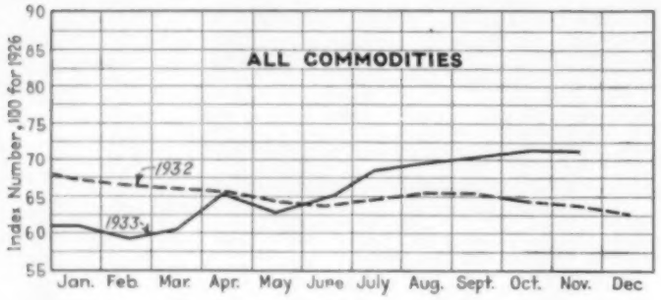
	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.11 -$0.11½	$0.11 -$0.11½	$0.10 -$0.11
Acid, acetic, 28%, bbl., cwt.	2.90 - 3.15	2.90 - 3.15	2.65 - 2.90
Glacial 99%, drums	10.02 -10.27	10.02 -10.27	8.89 -
U. S. P. reagent, c'boys	10.52 -10.77	10.52 -10.77	9.64 - 9.89
Boric, bbl., lb.	.04½- .05	.04½- .05	.04½- .05
Citric, kegs, lb.	.28 - .31	.29 - .31	.29 - .31
Formic, bbl., lb.	.11 - .11½	.11 - .11½	.10 - .11
Gallic, tech., bbl., lb.	.60 - .65	.60 - .65	.50 - .55
Hydrofluoric 30% carb., lb.	.07 - .07½	.07 - .07½	.06 - .07
Lactic, 44%, tech., light, bbl., lb.	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18° tanks, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -	18.50 -20.00
Oxalic, crystals, bbl., lb.	.11½- .12½	.11½- .12½	.11 - .12
Phosphoric, tech., c'boys., lb.	.09 - .10	.09 - .10	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Sulphuric, 66°, tanks, ton	15.50 -	15.50 -	15.50 -
Tannic, tech., bbl., lb.	.23 - .35	.23 - .35	.23 - .35
Tartaric, powd., bbl., lb.	.25½- .26	.25½- .26	.20 - .21
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	4.15½-	2.41⅝-	2.53½-
Alcohol, Butyl, tanks, lb.	.095-	.095-	.113-
Alcohol, Amyl	-	-	-
From Pentane, tanks, lb.	.15 -	.15 -	.143-
Denatured, 190 proof			
No. 1 special dr., gal.	.346-	.346-	.34½-
No. 5, 188 proof, dr., gal.	.34 -	.34 -	.38½-
Alum, ammonia, lump, bbl., lb.	.03 - .04	.03 - .04	.03 - .04
Chrome, bbl., lb.	.04½- .05	.04½- .05	.04½- .05
Potash, lump, bbl., lb.	.03 - .04	.03 - .04	.03 - .04
Aluminum sulphate, com., bags, cwt.	1.35 - 1.50	1.35 - 1.50	1.25 - 1.40
Iron free, bg., cwt.	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb.	.02½- .03	.02½- .03	.02½- .03
tanks, lb.	.02½- .02¾	.02½- .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb.	.15½- .16	.14 - .14½	.15½- .15½
tanks, lb.	.05 -	.05 -	.05 -
Ammonium carbonate, powd. tech., casks, lb.	.08 - .12	.08 - .12	.10 - .11
Sulphate, wks., cwt.	1.25 -	1.25 -	1.00 -
Amylacetate tech., tanks, lb., gal	.14½-	.14½-	.135-
Antimony Oxide, bbl., lb.	.08½- .10	.08½- .10	.07 - .08
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs, lb.	.14 - .14½	.14 - .14½	.09 - .10
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	56.50 -58.00
Chloride, bbl., ton	74.00 -75.00	74.00 -75.00	63.00 -65.00
Nitrate, cask, lb.	.08½- .09	.08½- .09	.07½- .07½
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f.o.b., wks., drums, cwt.	1.85 - 2.00	1.85 - 2.00	1.75 - 2.00
Borax, grain, bags, ton	40.00 -45.00	40.00 -45.00	40.00 -45.00
Bromine, cs., lb.	.36 - .38	.36 - .38	.36 - .38
Calcium acetate, bags	3.00 -	3.00 -	2.50 -
Arsenate, dr., lb.	.07 - .08	.07 - .08	.05½- .06½
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	17.50 -	17.50 -	18.00 -
flake, dr., wks., ton.	19.50 -	19.50 -	21.00 -
Phosphate, bbl., lb.	.07½- .08	.07½- .08	.07½- .08
Carbon bisulphide, drums, lb.	.05½- .06	.05½- .06	.05 - .06
Tetrachloride drums, lb.	.05½- .06	.05½- .06	.06½- .07
Chlorine, liquid, tanks, wks., lb.	.0185-	.0185-	.01½-
Cylinders	.05½- .06	.05½- .06	.05½- .06
Cobalt oxide, cans, lb.	1.35 - 1.40	1.35 - 1.40	1.25 - 1.35
Copperas, bgs., f.o.b. wks., ton.	14.00 -15.00	14.00 -15.00	13.00 -14.00
Copper carbonate, bbl., lb.	.08½- .16	.08½- .16	.07 - .16
Cyanide, tech., bbl., lb.	.39 - .44	.39 - .44	.39 - .44
Sulphate, bbl., cwt.	3.75 - 4.00	3.75 - 4.00	3.00 - 3.25
Cream of tartar, bbl., lb.	.18 - .18½	.18 - .18½	.14½- .15
Diethylene glycol, dr., lb.	.14 - .16	.14 - .16	.14 - .16
Epsom salt, dom., tech., bbl., cwt.	2.10 - 2.15	2.10 - 2.15	1.70 - 2.00
Imp., tech., bags, cwt.	2.00 - 2.10	2.00 - 2.10	1.15 - 1.25
Ethyl acetate, drums, lb.	.08½-	.08½-	.09 -
Formaldehyde, 40%, bbl., lb.	.06 - .07	.06 - .07	.06 - .07
Furfural, dr., contract, lb.	.10 - .17½	.10 - .17½	.10 - .17½
Fusel oil, crude, drums, gal.	.75 -	.75 -	1.10 - 1.20
Refined, dr., gal.	1.25 - 1.30	1.25 - 1.30	1.80 - 1.90
Glaubers salt, bags, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Glycerine, c.p., drums, extra, lb.	.11½- .11¾	.11 - .11½	.10½- .10½
Lead:			
White, basic carbonate, dry casks, lb.	.06½-	.06½-	.06½-
White, basic sulphate, sck., lb.	.06 -	.06 -	.06 -
Red, dry, sck., lb.	.07½-	.07½-	.06½-
Lead acetate, white crys., bbl., lb.	.10½- .11	.10½- .11	.10 - .11
Lead arsenate, powd., bbl., lb.	.10 - .13	.10 - .13	.09 - .14
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk, lb.	.06½-	.06½-	.05½-
Lithophone, bags, lb.	.04½- .05	.04½- .05	.04½- .05
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.05½- .06
Methanol, 95%, tanks, gal.	.33 -	.33 -	.33 -
97%, tanks, gal.	.34 -	.34 -	.34 -
Synthetic, tanks, gal.	.35½-	.35½-	.35½-
Nickel salt, double, bbl., lb.	.11½- .12	.11½- 12	.11 - .11½
Orange mineral, csk., lb.	.10½-	.10½-	.09 -
Phosphorus, red, cases, lb.	.45 - .46	.45 - .46	.42 - .44
Yellow, cases, lb.	.28 - .32	.28 - .32	.28 - .32
Potassium bichromate, casks, lb.	.07½- .08½	.07½- .08½	.07 - .08
Carbonate, 80-85%, calc. csk., lb	.07 - .07½	.07 - .07½	.05 - .06
Chlorate, powd., lb.	.09 - .09½	.09 - .09½	.08 - .08½
Hydroxide (c'stic potash) dr., lb.	.07½- .07½	.07½- .07½	.06½- .06½
Muriate, 80% bgs., ton	37.15 -	37.15 -	37.15 -
Nitrate, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb.	.18½- .19	.18½- .19	.16 - .16½
Prussiate, yellow, casks, lb.	.18 - .19	.18 - .19	.17½- .18
Sal ammoniac, white, casks, lb.	.04½- .05	.04½- .05	.04½- .05
Salsoda, bbl., cwt.	1.00 - 1.05	1.00 - 1.05	.90 - .95
Salt cake, bulk, ton	13.00 -15.00	13.00 -15.00	13.00 -15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 -	1.23 -	1.15 -
Dense, bags, cwt.	1.25 -	1.25 -	1.17½-
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 - 3.00	2.60 - 3.00	2.50 - 2.75
Acetate, works, bbl., lb.	.04½- .05	.04½- .05	.05 - .05½
Bicarbonate, bbl., cwt.	1.85 - 2.00	1.85 - 2.00	1.85 - 2.00
Bichromate, casks, lb.	.05½- .06½	.05½- .06½	.04½- .05
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb.	.03 - .04	.03 - .04	.03½- .04
Chlorate, kegs, lb.	.06½- .06½	.06½- .06½	.05½- .07½
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.00
Cyanide, cases, dom., lb.	.15½- .16	.15½- .16	.15½- .16
Fluoride, bbl., lb.	.07½- .08	.07½- .08	.07½- .08
Hyposulphite, bbl., lb.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt.	3.25 - 3.40	3.25 - 3.40	3.60 - 3.75
Nitrate, bags, cwt.	1.35 -	1.35 -	1.295-
Nitrite, casks, lb.	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	.021- .023	.021- .023	.018- .02
Prussiate, yel. drums, lb.	.11½- .12	.11½- .12	.11½- .12
Silicate (40° dr.) wks. cwt.	.80 - .85	.80 - .85	.70 - .75
Sulphide, fused, 60-62%, dr., lb.	.02½- .03½	.02½- .03	.02½- .03
Sulphite, cyrs., bbl., lb.	.02½- .02½	.02½ .02½	.03 - .03½
Sulphur, crude at mine, bulk, ton	18.00 -	18.00 -	18.00 -
Chloride, dr., lb.	.03½- .04	.03½- .04	.03½- .04
Dioxide, cyl., lb.	.07 - .07½	.07 - .07½	.06½- .07
Flour, bag, cwt.	1.60 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin Oxide, bbl. lb.	.55 -	.57 -	.27½-
Crystals, bbl., lb.	.37½-	.38½-	.24 -
Zinc chloride, gran., bbl., lb.	.05½- .06	.05½- .06	.06½- .06½
Carbonate, bbl., lb.	.09½- .11	.09½- .11	.10½- .11
Cyanide, dr., lb.	.38 - .42	.38 - .42	.38 - .42
Dust, bbl., lb.	.07 - .07½	.07 - .07½	.04½- .05
Zinc oxide, lead free, bag, lb.	.05½-	.05½-	.05½-
5% lead sulphate, bags, lb.	.05½-	.05½-	.05½-
Sulphate, bbl., cwt.	3.00 - 3.25	3.00 - 3.25	3.00 - 3.25

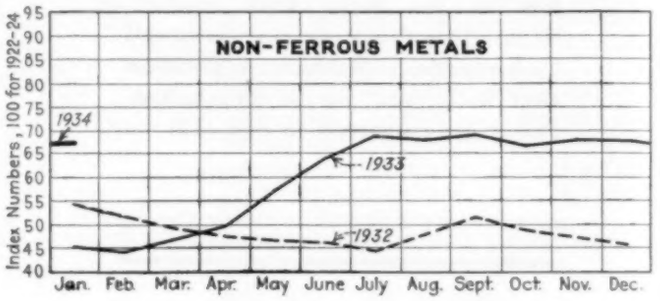
Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.09½-$0.10	$0.09½-$0.10	$0.08½-$0.09
Chinawood oil, bbl., lb.	.07½-	.08 -	.05½-
Coconut oil, Ceylon, tanks, N. Y. lb.	.02½-	.02½-	.03 -
Corn oil crude, tanks, (f.o.b. mill), lb	.04½-	.03½-	.03 -
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.04 -	.03½-	.02½-
Linseed oil, raw car lots, bbl., lb.	.093-	.093-	.072-
Palm, Lagos, casks, lb.	.03½-	.03½-	.02½-
Palm Kernel, bbl., lb.	.04½-	.04½-	.04½-
Peanut oil, crude, tanks (mill), lb.	.04½-	.03½-	.03½-
Rapeseed oil, refined, bbl., gal.	.42 - .43	.42 - .43	.35 - .36
Soya bean, tank, lb.	.06 -	.06 -	-
Sulphur (olive foots), bbl., lb.	.06½-	.06½-	.04½-
Cod, Newfoundland, bbl., gal.	nom.	.34 - .35	.19 - .21
Menhaden, light pressed, bbl., lb.	.051-	.053-	.03½-
Crude, tanks (f.o.b. factory), gal.	.15 -	.15 -	.09 -
Grease, yellow, loose, lb.	.02½-	.02½-	.02 -
Oleo stearine, lb.	.05½-	.05 -	.03½-
Red oil, distilled, d.p. bbl., lb.	.07 -	.06½-	.06 -
Tallow, extra, loose, lb.	.03½-	.03 -	.01½-









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.14½- .15	.14½- .15	.14½- .15
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .52
Benzaldehyde, U.S.P., dr., lb.	1.10 - 1.25	1.10 - 1.25	1.10 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.	.48 - .52	.48 - .52	.48 - .52
Benzyl chloride, tech., dr., lb.	.30 - .35	.30 - .35	.30 - .35
Bensol, 90%, tanks, works, gal.	.20½- .21	.20½- .21	.20 - .21
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U. S. P., dr., lb.	.11 - .11½	.11 - .11½	.10½- .11
Cresylic acid, 97%, dr., wks., gal.	.50 - .51	.50 - .51	.42 - .45
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb.	.29 - .30	.29 - .30	.29 - .30
Dinitrotoluen, bbl. lb.	.16 - .17	.16 - .17	.16 - .17
Dip oil 25% dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb.	.38 - .40	.38 - .40	.38 - .40
H-acid, bbl., lb.	.65 - .70	.65 - .70	.65 - .70
Naphthalene, flake, bbl., lb.	.06 - .07	.06 - .07	.04½- .05
Nitrobenzene, dr., lb.	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.51 - .55
Phenol, U.S.P., drums, lb.	.14½- .15	.14½- .15	.14½- .15
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., gal.	1.10 - 1.15	1.10 - 1.15	.90 - .95
Resorcinal, tech., kegs, lb.	.65 - .70	.65 - .70	.65 - .70
Salicylic acid, tech., bbl., lb.	.40 - .42	.40 - .42	.40 - .42
Solvent naphtha, w.w., tanks, gal.	.26 -.....	.26 -.....	.26 -.....
Tolidine, bbl., lb.	.88 - .90	.88 - .90	.86 - .88
Toluene, tanks, works, gal.	.30 -.....	.30 -.....	.30 -.....
Xylene, com., tanks, gal.	.26 -.....	.26 -.....	.26 -.....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb.	.11½- .13	.12½- .13	.07 - .10½
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.04 - .20	.04 - .20	.02½- .20
Prussian blue, bbl., lb.	.35 - .37	.35 - .36	.35 - .36
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb.	.26 - .27	.26 - .27	.27 - .30
Carmine red, tins, lb.	4.00 - 4.40	4.00 - 4.40	3.90 - 4.50
Para toner, lb.	.80 - .85	.80 - .85	.75 - .80
Vermilion, English, bbl., lb.	1.48 - 1.50	1.40 - 1.45	1.10 - 1.30
Chrome yellow, C. P., bbl., lb.	.15 - .16	.15 - .15½	.16 - .16½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.07 - .08½	.07 - .08½
Gum copal Congo, bags, lb.	.09 - .10	.08 - .09	.06 - .08
Manila, bags, lb.	.09 - .10	.09 - .10	.16 - .17
Damar, Batavia, cases, lb.	.15½- .16	.15 - .15½	.16 - .16½
Kauri No. 1 cases, lb.	.20 - .25	.20 - .25	.45 - .48
Kieselguhr (f.o.b. N.Y.), ton.	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton.	50.00 -.....	50.00 -.....	40.00 -.....
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	6.175-.....	5.35 -.....	4.00 -.....
Turpentine, gal.	.60½-.....	.51 -.....	.44½-.....
Shellac, orange, fine, bags, lb.	.26 - .27	.26 - .27	.19 - .20
Bleached, bonedry, bags, lb.	.29 - .31	.29 - .31	.18 - .19
T. N. bags, lb.	.21 - .22	.21 - .22	.08½- .09
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b Ga.), ton.	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 -.....	13.75 -.....	13.75 -.....

INDUSTRIAL NOTES

THE PFAUDLER CO., Rochester, N. Y., has appointed Edward S. Heinsohn as its sales representative in western Pennsylvania, southeastern Ohio, eastern West Virginia, and northwestern Maryland. A. M. Andrews and Fred Jones have been added to the Chicago sales staff and R. C. Marine, formerly of Chicago, now represents the company in the southern territory.

THE CALCIUM CHLORIDE ASSOCIATION of which Ray A. Giddings is secretary, has moved into larger quarters in the Penobscot Bldg., Detroit, Mich. During the last year B. C. Tiney joined the association as chief engineer and Fred Burggraf was appointed soils engineer.

POOLE FOUNDRY & MACHINE CO., Baltimore, Md., has appointed the J-B Engineering Sales Co., New Haven, as its representative in Connecticut and Frank M. Young will serve in similar capacity in the Milwaukee, Wis., district.

DIAMOND CHAIN & MFG. CO., Indianapolis, Ind., has named Rodney Davis, 624 Race St., Philadelphia, as distributor of its products in the Philadelphia territory.

MASON-NEILAN REGULATOR CO., Boston, Mass., has transferred Donavon B. Church from the San Francisco branch office to the factory engineering department.

A. M. BYERS CO., Pittsburgh, Pa., has placed J. B. Durkee in charge of the Houston office of the company. Mr. Durkee succeeds H. B. Weathersby who died Dec. 19 as the result of an automobile accident.

THE ROBERT J. KING CO., manufacturing chemists, Stamford, Conn., has moved its entire business to South Norwalk.

HIERGESELL BROTHERS, manufacturers of instruments and chemical glassware, Philadelphia, Pa., has changed the company name to the H-B Instrument Co., Inc.

ALSOP ENGINEERING CORP., has opened a sales and service department in the Bourse, Philadelphia. William Engesser is in charge and in addition to his office address may be contacted at night at 1531 N. Broad St.

THE EDWAL LABORATORIES, Chicago, will undertake the manufacture, on special order, of chemicals not otherwise commercially available.

WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J., has added A. G. Pratt, president of The Babcock & Wilcox Co., to its board of directors.

Technical Societies and Trade Associations

ALABAMA-Florida Pitch Pine Export Assn. Sec., Wilmer Hayward, 832 Whitney Bldg., New Orleans, La.

Aluminum Research Institute. R. D. T. Hollowell, 308 West Washington St., Chicago, Ill

Amer. Assn. for the Advancement of Science. Perm. Sec., Henry B. Ward Smithsonian Inst. Bldg., Washington, D. C.

Amer. Assn. of Cereal Chemists. Sec.-Treas., M. D. Mize, 833 Omaha Grain Exchange, Omaha, Neb.

Amer. Assn. of Engrs. Sec., M. E. McIver, 8 S. Michigan Blvd., Chicago, Ill.

Amer. Assn. of Textile Chemists & Colorists. Sec., A. Newton Graves, c/o Franklin Process Co., Providence, R. I.

Amer. Bakers' Assn. Pres., Henry Stude; Sec., Tom Smith, 1135 Fullerton Ave., Chicago, Ill.

Amer. Bleached Shellac Mfrs.' Assn. Sec., R. W. McClintock, 80 Cliff St., New York.

Amer. Bureau of Metal Statistics. Director, W. R. Ingalls, 33 Rector St., New York.

Amer. Ceramic Society. Gen. Sec., Ross C. Purdy, 2525 N. High St., Columbus, Ohio.

Amer. Chemical Society. Sec., Dr. Charles L. Parsons, Mills Bldg., Washington, D. C.

Amer. Concrete Institute. Sec., Harvey Whipple, 642 New Center Bldg., Detroit, Mich.

Amer. Drug Mfrs.' Assn. Exec. Vice-Pres. and Sec., Carson P. Frailey, 506 Albee Bldg., Washington, D. C.

Amer. Electro-Platers' Soc. Sec., H. A. Gilbertson, 434 So. Wabash Ave., Chicago, Ill.

Amer. Engineering Council. Exec. Sec., F. E. Feiker, 744 Jackson Pl., Washington, D. C.

Amer. Foundrymen's Assn. Exec. Sec.-Treas., C. E. Hoyt, 222 W. Adams St., Chicago, Ill.

Amer. Gas Assn. Man. Dir., Alexander Forward, 420 Lexington Ave., New York.

Amer. Glassware Assn. Sec., C. E. Voitle, 19 West 44th St., New York.

Amer. Inst. of Baking. Dean, C. B. Morison, 1135 Fullerton Ave., Chicago, Ill.

Amer. Inst. of Chemical Engrs. Sec. and Exec. Sec., F. J. LeMaistre, Bellevue Court Bldg., Phila., Pa.

Amer. Inst. of Chemists. Sec., Howard S. Neiman, 2110 Woolworth Bldg., New York.

Amer. Inst. of Consulting Engrs. Sec. and Treas., Philip W. Henry, 75 West St., New York.

Amer. Inst. of Electrical Engrs. Nat. Sec., H. H. Henline, 33 W. 39th St., New York.

Amer. Inst. Laundry, Drawer 1187, Joliet, Ill.

Amer. Inst. of Mining & Metallurgical Engrs. Sec., A. B. Parsons, 29 W. 39th St., New York.

Amer. Inst. of Refrigeration. Gen. Sec., J. F. Nickerson, 433 N. Waller Ave., Chicago, Ill.

Amer. Lampblack Mfrs.' Assn. Pres., March G. Bennett, 141 Milk St., Boston, Mass.

Amer. Leather Chemists' Assn. Sec., H. C. Reed, 143 W. 20th St., New York.

Amer. Management Assn. Man. Dir., John G. Goetz, 20 Vesey St., New York.

Amer. Manganese Products' Assn. Pres., J. Carson Adkerson, National Press Bldg., Washington, D. C.

Amer. Mfrs.' Export Assn. Vice-Pres. and Gen. Mgr., Francis T. Cole, 330 W. 42d St., New York.

Amer. Museum of Safety. Dir., Albert A. Hopkins, Office, 1170 Broadway; Museum, 120 E. 28th St., New York.

Amer. Oil Burner Assn. Exec. Sec., Harry F. Tapp, 342 Madison Ave., New York.

Amer. Oil Chemists' Society. Sec., J. C. P. Helm, 705 Tchoupitoulas St., New Orleans, La.

Amer. Paper & Pulp Assn. Sec., Charles W. Boyce; 370 Lexington Ave., New York.

Amer. Petroleum Inst. Exec. Vice-Pres., W. R. Boyd, Jr.; Sec., Lacey Walker, 250 Park Ave., New York.

Amer. Pharmaceutical Mfrs.' Assn. Sec., Clarence W. Warner, 580 Fifth Ave., New York.

Amer. Photo-Engravers' Assn. Louis Floder, 166 W. Van Buren St., Chicago, Ill.

Amer. Physical Soc. Sec., W. L. Severinghaus, Columbia Univ., New York.

Amer. Pulp & Paper Mill Superintendents' Assn., Inc. Sec., R. L. Eminger, 54 N. Main St., Miamisburg, Ohio.

Amer. Refractories Institute. Sec., Dorothy A. Texter, 2202 Oliver Bldg., Pittsburgh, Pa.

Amer. Soc. for Steel Treating. Sec., W. H. Eisenman, 7016 Euclid Ave., Cleveland, Ohio.

Amer. Soc. for Testing Materials. Sec.-Treas., C. L. Warwick, 260 S. Broad St., Philadelphia, Pa

Amer. Soc. of Bakery Engrs. Sec.-Treas., Victor E. Marx, 1541 Birchwood Ave., Chicago, Ill.

Amer. Soc. of Civil Engrs. Sec., George T. Seabury, 33 W. 39th St., New York.

Amer. Soc. of Heating & Ventilating Engrs. Sec., A. V. Hutchinson, 51 Madison Ave., New York.

Amer. Soc. of Lubrication Engrs. Sec.-General, F. C. Otto, Dayton, Ohio.

Amer. Soc. of Mechanical Engrs. Sec., Calvin W. Rice, 29 W. 39th St., New York.

Amer. Soc. of Refrigerating Engrs. Sec., David L. Fiske, 37 W. 39th St., New York.

Amer. Soc. of Safety Engrs. Sec., W. Dean Keefer, 20 N. Wacker Drive, Chicago, Ill.

Amer. Standards Assn. Sec., P. G. Agnew, 29 W. 39th St., New York.

Amer. Water Works Assn. Sec. B. C. Little, 29 West 39th St., New York.

Amer. Welding Soc. Sec., Miss M. M. Kelly, 33 W. 39th St., New York.

Amer. Wood-Preservers' Assn. Sec. H. L. Dawson, 1427 Eye Street, N. W., Washington, D. C.

Amer. Zinc Inst., Inc. Sec., Julian D. Conover, 60 E. 42d Street, New York.

Asphalt Institute. Managing Director, J. E. Pennybacker, 801 Second Ave., New York.

Asphalt Shingle and Roofing Institute. Mgr., J. S. Bryant, 2 West 45th St., New York.

Associated Cooperage Industries of Amer. Sec. L. F. Horn, 411 Olive St., St. Louis, Mo.

Assn. of American Soap & Glycerine Producers, Inc. Mgr. R. C. Edlund, 386 Fourth Ave., New York.

Assn. of British Chemical Mfrs. Gen.-Mgr. & Sec., J. Davidson Pratt, 166 Piccadilly, London, W. 1, England.

Assn. of Consulting Chemists and Chemical Engineers, Inc. Sec., Dr. Paul Mahler, 50 E. 41st St., New York.

Assn. of Official Agricultural Chemists. Sec., W. W. Skinner, Box 290, Pennsylvania Ave. Station, Washington, D. C.

BISCUIT & Cracker Mfrs.' Assn. Sec., R. T. Stokes, 233 Broadway, New York.

Brake Lining Mfrs.' Assn., Inc. Gen. Mgr., W. Joseph Littlefield, 370 Lexington Ave., New York.

Brick Mfrs.' Assn. of Amer., The. Sec., Ralph P. Stoddard, 2121 Guarantee Title Bldg., Cleveland, Ohio.

British Assn. for the Advancement of Science. Sec., O. J. R. Howarth, Burlington House, Piccadilly, London, W. 1, England.

British Cast Iron Research Assn. Dir. and Sec., J. G. Pearce, 21-23 St. Paul's Square, Birmingham, England.

British Non-Ferrous Metals Research Assn. Sec., Arthur F. Ridley, Regnart Bldg., Euston St., London, N. W. 1.

Bureau of Raw Materials for American Vegetable Oils & Fats Industries. Sec., John B. Gordon, 1251 National Press Bldg., Washington, D. C.

CALCIUM Chloride Assn. Sec., Ray A. Giddings, 4200 Penobscot Bldg., Detroit, Mich.

Canadian Engineering Standards Assn. Sec., B. Stuart McKenzie, Room 3064, National Research Building, Ottawa, Ont., Canada.

Canadian Inst. of Chemistry. Sec., L. E. Westman, 366 Adelaide St., W., Toronto 2, Ont., Canada.

Canadian Inst. of Mining & Metallurgy. Sec., E. J. Carlyle, 923 Drummond Bldg., Montreal, Canada.

Canadian Pulp & Paper Assn. Sec., A. E. Cadman, 3420 University St., Montreal, Que., Canada.

Canadian Society of Forest Engrs. Sec., A. H. Richardson, Parliament Buildings, Toronto 5, Ont., Canada.

Carbon Black Export, Inc. Pres., C. E. Kayser, 500 Fifth Ave., New York.

Casein Plastics Mfrs.' and Fabricators Assn. Sec., R. T. Baldwin, 50 East 41st St., New York.

Cellulose Plastics Mfrs.' Assn. Sec., John E. Walker, 1001 Fifteenth Street, N. W., Washington, D. C.

Ceramic Assn. of New Jersey. Pres., J. M. Gilfillan, c/o Trumbull Electric Mfg. Co., Trenton, N. J. Sec., Geo. H. Brown, P. O. Box 444, Rutgers University, New Brunswick, N. J.

Ceramic Society. Sec., Dr. J. W. Mellor, North Staffordshire Technical College, Stoke-on-Trent, England.

Cercle de la Chimie. Sec., Rene Dage, 54 Rue de Turbigo, Paris, France.

Chemical Alliance. Sec., W. N. Watson, 535 Fifth Ave., New York.

Chemical Club of Philadelphia. Sec., G. B. Heckel, Jr., Cunard Bldg., Philadelphia, Pa.

Chemical Engineering Equipment Institute. Sec., D. H. Killeffer, 50 E. 41st St., New York.

Chemical Fire Extinguisher Assn. Commissioner, W. J. Parker, 7 E. 44th St., New York.

Chemical Foundation. Wm. W. Buffum, 654 Madison Ave., New York.

Chemical, Metallurgical & Mining Society of South Africa, Inc. Sec., H. A. G. Jeffreys, Kelvin House, 100 Fox St., Johannesburg, Transvaal, South Africa.

Chemists' Club, The. Sec., Robert T. Baldwin, 52 E. 41st St., New York.

Chicago Drug and Chemical Assn. Sec., A. G. Schneider, Rm. 3000, 141 W. Jackson Blvd., Chicago, Ill.

Chicago Perfumery, Soap & Extract Assn. Sec., W. Kedzie Teller, Columbus Laboratories, Chicago, Ill.

Chilean Nitrate Educational Bureau, Inc. Director, H. C. Brewer, 120 Bway., New York.

Chlorine Institute, Inc., The. Sec., Robert T. Baldwin, 50 East 41st St., New York.

Clay Products Assn. Sec. and Consulting Engineer, George C. D. Lenth, 111 W. Washington St., Chicago, Ill.

Commodity Exchange, Inc. Sec., Walter Dutton, 81 Broad St., New York.

Compressed Air Institute. Sec., C. H. Rohrbach, Room 1512, 90 West St., New York.

Compressed Gas Mfrs.' Assn., Inc. Sec.-Treas., Franklin R. Fetherston, 110 W. 40th St., New York.

Copper & Brass Research Assn. Man. Dir., H. Foster Bain; Sec., Bertram B. Caddle, Mgr., W. A. Willis, 25 Broadway, New York.

Corn Industries Research Foundation. Director, H. E. Barnard, 225 Wimmer Bldg., Indianapolis, Ind.

DEUTSCHE Bunsen-Gesellschaft fur angewandte physikalische Chemie e.V., Seelze, bei Hannover No. 197, Germany.

Deutsche Chem. Gesellschaft. Sec. Prof. Dr. A. Binz, Sigismundstr. 4, Berlin W. 35, Germany.

Deutsche Gesellschaft fur Mineralolforschung. Sec., Dr.-Ing. Oscar Zaepke, Dorotheenstr. 40, Berlin NW 7, Germany.

Deutscher Verband fur die Materialprufungen der Technik. Sec., Regierungsrat Deutsch, Dorotheenstr., 40, Berlin NW 7, Germany.

Drug, Chemical and Allied Trades Section, New York Board of Trade, Inc. Sec., Ray C. Schlotterer, 41 Park Row, New York.

EDIBLE Gelatin Mfrs.' Research Society of America, Inc. Sec., H. B. Sweatt, 55 West 42d St., New York.

Edison Electric Institute. Vice-Pres. and Managing Director, Bernard F. Weadock, 420 Lexington Ave., New York.

Electrochemical Soc. Sec., Dr. C. G. Fink, Columbia Univ., New York.

Empire Council of Mining & Metallurg-

ical Institutions. Sec.-Gen., Chas. McDermid, Cleveland House, 225, City Road, London, E.C.1, England.
Engineering Inst. of Canada, The. Sec., R. J. Durley, 2050 Mansfield St., Montreal, Que., Canada.

FARADAY Society, The. Sec., G. S. W. Marlow, 13 South Square, Gray's Inn, London, W. C. 1, England.
Federation of Paint & Varnish Production Clubs. Sec., G. M. Heckel, 902 Cunard Bldg., 220 S. 16th St., Philadelphia, Pa.
Federal Wholesale Druggists' Assn. Sec., R. E. Lee Williamson, 123 Market Place, Baltimore, Maryland.
Florida Agricultural Research Institute. Sec., W. C. Johnson, 509-510 Taylor Bldg., Winter Haven, Fla.
Florida Hard Rock Phosphate Export Assn. J. M. Extrowich, P. O. Box 157, Savannah, Ga.
Franklin Inst. of the State of Pa., The, and Benjamin Franklin Memorial. Sec., and Dir., Howard McClenahan, The Parkway at Twentieth St., Philadelphia, Pa.
Fur Dressers & Fur Dryers' Assn., Inc. Sec., William Beyer, Jr., 128 West 31st St., New York.

GAS Products Assn. Sec., Mr. Lloyd Keenan, 350 E. Ontario St., Chicago, Ill.
Glass Container Assn. Sec., & Treas., V. L. Hall, 19 West 44th St., New York.
Glycerine Producers' Assn. Mgr., R. C. Edlund, 386 Fourth Ave., New York.
Gypsum Assn. Sec., H. J. Schweim, 211 W. Wacker Drive, Chicago, Ill.

HAWAIIAN Sugar Planters' Assn. Director of Experiment Station, H. P. Agee, P. O. Box 411, Honolulu, Hawaii.
Hydraulic Institute. Sec., C. H. Rohrbach, Room 1512, 90 West Street, New York.

ILLUMINATING Engineering Society. Gen. Sec., D. W. Atwater, 29 W. 39th St., New York.
Independent Fertilizer Mfrs.' Assn., Inc. Sec.-Treas., J. S. Whittington, 342 Madison Ave., New York.
Industrial Alcohol Institute, Inc., 420 Lexington Ave., New York.
Inland Fertilizer Assn. Sec., Richard H. Roop, 614 N. Calvert St., Baltimore, Maryland.
Institute of Amer. Meat Packers. Pres., Wm. Whitfield Woods, 59 East Van Buren Street, Chicago, Ill.
Institute of Leather Cloth & Lacquered Fabrics Mfrs. Sec., C. Stewart Comeaux, 103 Park Ave., New York.
Institute of Makers of Explosives. Sec., C. Stewart Comeaux, 103 Park Ave., New York.
Institute of Margarine Mfrs. Sec., Dr. J. S. Abbott, 939 Munsey Bldg., Washington, D. C.
Institute of Metals. Sec., G. Shaw Scott, 36 Victoria St., Westminster, London, S. W. 1; England.
Institute of Paint & Varnish Research. H. A. Gardner, 2201 New York Ave., N. W., Washington, D. C.
Institute of Radio Engineers, Inc., The. Sec., Harold P. Westman, 33 West 39th St., New York.
Institution of Chemical Engineers. Hon. Sec., H. W. Cremer, Abbey House, Westminster, London, S. W. 1, England.
Institution of Mining Engineers. Sec., Charles McDermid, Cleveland House, 225, City Road, London, E. C. 1, England.
Institution of Mining & Metallurgy. Sec., Charles McDermid, Cleveland House, 225 City Road, London, E. C. 1, England.
Institution of Petroleum Technologists. Sec., S. J. Astbury, M. A., A.M. Inst. C. E., Aldine House, Bedford St., Strand, London, W. C. 2, England.
International Society of Leather Trades' Chemists. Hon. Gen. Sec. Dr. J. Gordon Parker, 17, Market St., London, S. E. 1, England. Editorial and Publication Offices also at 17, Market St., London, S.E. 1.
Iron & Steel Institute. Sec., K. Headlam-Morley, 28 Victoria St., London, S. W. 1, England.

JUNIOR Institution of Engineers. Sec., Herbert G. Riddle, 39 Victoria St., Westminster, S. W. 1, England.

Jute and Gunnies Importers Assn. Sec., Thomas J. Hastings, 150 Washington St., New York.

LACQUER Institute. Sec., H. B. Sweatt, 55 West 42d St., New York.
Lacquer Mfrs.' Assn. Sec., J. P. Hubbell, 420 Lexington Ave., New York.
Lead Industries Assn. Sec., F. E. Wormser, 420 Lexington Ave., New York, N. Y.
Linseed Assn. of N. Y. Sec., Thomas J. Hastings, 150 Washington St., New York.

MANUFACTURING Chemists' Assn. of the U. S. Sec., W. N. Watson, 608 Woodward Bldg., Washington, D. C.
Master Electroplaters Institute, The. R. J. Nagel, 3835 Beiss Ave., Toledo, Ohio.
Metric Assn. Sec., Howard Richards, Pottsville, Pa.
Mining & Metallurgical Soc. of Amer. Sec., Percy E. Barbour, 76 Beaver St., New York.

NATIONAL Academy of Sciences. Home Sec., Dr. Fred E. Wright, 2101 Constitution Ave., Washington, D. C.
National Assn. of Cost Accountants. Sec., Stuart C. McLeod, 1790 Broadway, New York.
National Assn. of Cotton Mfrs. Sec., Russell T. Fisher, 80 Federal St., Boston, Mass.
National Assn. of Dyers and Cleaners of the United States and Canada. Man. Dir., Walter H. Franks, 7901 Georgia Ave., Silver Spring, Md.
National Assn. of Glue Mfrs.' Inc. Sec., H. B. Sweatt, 55 West 42d St., New York.
National Assn. of Importers of Hides & Skins, Inc. Exec. Sec., Eugenia R. Arnold, P. O. Box 197, City Hall Annex, New York.
National Assn. of Insecticide and Disinfectant Mfrs.', Inc. Sec., Harry W. Cole, P. O. Box 428, Holbrook, Mass.
National Assn. of Mfrs.' Sec., Noel Sargent, 11 West 42d St., New York.
National Assn. of Mfrs. of Pressed & Blown Glassware. Sec. & Treas., C. E. Voitle, 34 Conestoga Bldg., Pittsburgh, Pa.
National Assn. of Printing Ink Makers. Sec., David H. Sloane, 1440 Broadway, New York, N. Y.
National Assn. of Purchasing Agents. Sec.-Treas., G. A. Renard, 11 Park Place, New York.
National Assn. of Retail Druggists, The. Sec., John W. Dargavel, 168 North Michigan Ave., Chicago, Ill.
National Assn. of Textile Printing Colorists. Sec., Fred L. Babcock, 465 Main St., Cambridge, Mass.
National Assn. of Textile Dyers & Finishers. Exec. Sec., Frederic L. Babcock, 465 Main St., Cambridge, Mass.
National Battery Mfrs.' Assn. Commissioner, W. J. Parker, 7 E. 44th St., New York.
National Canners' Assn. Sec., Frank E. Gorrell, 1739 H. St., N. W., Washington, D. C.
National Clean Up and Paint Up Campaign Bureau, Ralph W. Emerson, Exec. Sec., 2201 New York Ave., N. W., Washington, D. C.
National Coal Assn. Exec. Sec., C. B. Huntress, 804 Southern Bldg., Washington, D. C.
National Conference of Business Paper Editors. Sec., H. J. Payne, 330 West 42d St., New York.
National Electrical Mfrs.' Assn. Man. Dir., A. W. Berresford, 155 East 44th St., New York.
National Fertilizer Assn. Exec. Sec., Charles J. Brand, 616 Investment Bldg., Washington, D. C.
National Fire Protection Assn. Man. Dir., Franklin H. Wentworth, 60 Batterymarch St., Boston, Mass.
National Foreign Trade Council. Sec., Gardner L. Harding, 1 Hanover Sq., New York.
National Industrial Conference Board, Inc. Pres., Virgil Jordan. Sec., James M. Robertson, 247 Park Ave., New York.
National Industrial Council. Sec., Michael J. Hickey, 11 West 42d St., New York.
National Lime Assn. Pres. and Gen. Mgr., Norman G. Hough, 927 15th St., N. W., Washington, D. C.
National Metal Trades Assn. Sec., J. E. Nyhan, 122 So. Michigan Ave., Chicago, Ill.
National Oxygen and Acetylene Assn. Pres., John R. Gobey, Sec. and Treas., E. A. Tarlhauber, Mather Tower Bldg., 76 East Wacker Drive, Chicago, Ill.
National Paint, Varnish and Lacquer Assn., Inc. Sec. Emeritus G. B. Heckel, 901 Cunard Bldg., Philadelphia, Pa. Sec., Reuel W. Elton, 2201 New York Ave., N. W., Washington, D. C.
National Paving Brick Assn. Man. Dir., Geo. F. Schlesinger, National Press Bldg., Washington, D. C.
National Petroleum Assn. General Counsel, Fayette B. Dow, 930 Munsey Bldg., Washington, D. C.
National Pipe & Supplies Assn. Sec., R. Kennedy Hanson, 604 American Bank Bldg., Pittsburgh, Pa.
National Research Council. Chairman, Dr. Isaiah Bowman, 2101 Constitution Ave., Washington, D. C.
National Safety Council. Sec., W. H. Cameron, 20 N. Wacker Drive, Chicago, Ill.
National Soybean Oil Mfrs.' Assn. Sec., I. C. Bradley, Taylorville, Ill. Whitney H. Eastman, Pres., P. O. Box 603, Milwaukee, Wis.
National Stearic Acid Assn. Sec.-Treas., L. B. Platt, 19 West 44th St., New York.
National Wholesale Druggists Assn. Sec., E. L. Newcomb, 51 Maiden Lane, New York.
New Jersey Clay Workers Assn. Sec., G. H. Brown, Ceramics Dept., Rutgers College, New Brunswick, N. J.
New York Academy of Sciences. Sec., Dr. Roy Waldo Miner, 77th St. and Central Park West, New York.
N. Y. Wax Importers' Assn. Sec., Charles Christman, 121 Maiden Lane, New York.

OIL & Colour Chemists' Assn. Gen. Sec., James H. Aiken, 30 Russell Sq., London, W. C. 1, England.
Oil Trades Assn. of New York, Inc., Sec., Jos. C. Smith, 15 Moore St., New York.

PACKAGE Medicine Assn. Sec., A. C. Townsend, 16 S. Peoria St., Chicago, Ill.
Phosphate Export Assn. Sec., F. C. Noyes, 393 Seventh Ave., New York.
Pine Institute of America, Inc. Sec. Mgr., Carl F. Speh, Barnett National Bank Bldg., Jacksonville, Fla.
Plastic Mfg. Assn. Sec., John E. Walker, 1001-15th St., N.W., Washington, D. C.
Portland Cement Assn. Pres., Edward J. Mehren, Vice-Pres., Sec. and Gen. Mgr., William M. Kinney, 33 West Grand Ave., Chicago, Ill.

REICHSVERBAND der Deutschen Treibstoff-, Teer- und Erdolindustrie E.V., Berlin N.W. 7, Neustadtische Kirchstr. 3, Germany.
Rosin Oil Institute. Commissioner, D. S. Hunter, 2130 Keith Bldg., Cleveland, Ohio.
Rubber Growers' Assn., Inc. Sec., Frank G. Smith, 2, 3 and 4, Idol Lane, Eastcheap, London, E.C.3, England.
Rubber Mfrs.' Assn., Inc. Gen. Mgr., A. L. Viles, 250 West 57th St., New York.

SALT Producers' Assn. Sec., Frank Morse, 2137 Book Bldg., Detroit, Mich.
Sand-Lime Brick Assn., The. Sec., Miss Ellen Knight, 134 Ward St., Saginaw, Mich.
Scientific Apparatus Makers of America. Sec., J. M. Roberts, 20 N. Wacker Drive, Room 3014, Chicago, Ill.
Soap & Glycerine Producers' Assn. of America, Mgr., R. C. Edlund, 386 Fourth Ave., New York.
Societe de Chimie Industrielle. Vice-Pres., Delegate, Jean Gerard, 49 Rue des Mathurins, Paris, France.
Society for the Promotion of Engineering Education. Sec., Dr. F. L. Bishop, University of Pittsburgh, Pa.
Society of Chemical Industry Sec., H. J. Pooley, 46 Finsbury Sq., London, E.C.2, England.
Society of Chemical Industry (American Section). Sec., Foster D. Snell, 305 Washington St., Brooklyn, N. Y.
Society of Dyers & Colourists. Sec., J. B. Atkinson, 32-34 Piccadilly, Bradford, England.
Society of Glass Technology. Sec., Prof. W. E. S. Turner, Darnall Road, Sheffield, England.

Society of Industrial Engrs. Exec. Sec., George C. Dent, 205 West Wacker Drive, Chicago, Ill.

Sodium Phosphate Institute, Inc. Sec., Robert T. Baldwin, 50 East 42d St., New York.

Sodium Silicate Mfrs.' Institute. Sec., J. Passmore Elkinton, 121 South 3rd St., Philadelphia, Pa.

Solvents Institute, Inc., The. Exec. Officer, Robert T. Baldwin, 50 East 41st St., New York.

South African Chemical Institute. Hon. Sec., James Gray, F.I.C., P. O. Box 5254, Johannesburg, South Africa.

South African Institution of Engrs., Inc. Sec., W. W. R. Jago, Box 4609, Johannesburg, South Africa.

Sporting Arms and Ammunition Mfrs.' Institute. Sec.-Treas., C. Stewart Comeaux, 103 Park Ave., New York.

Steel Barrel Mfrs.' Council. Commissioner, D. S. Hunter, 2130 Keith Bldg., Cleveland, Ohio.

Sugar Institute, Inc., The. Exec. Vice-Sec., Fred G. Taylor, 129 Front St., New York.

Sulphite Paper Mfrs.' Assn., The. Sec.-Treas., Thos. J. Burke, 370 Lexington Ave., New York.

Synthetic Organic Chem. Mfrs.' Assn. of the U. S. Pres., August Merz, Room 507, 260 West Broadway, New York.

TANNERS' Council of America. Sec., J. L. Nelson, 41 Park Row, New York.

Taylor Society. Man. Dir., Harlow S. Person, 29 West 39th St., New York.

Technical Assn. of the Pulp & Paper Industry. Sec., R. G. Macdonald, 370 Lexington Ave., New York.

Technical Publicity Assn., Inc. Sec.-Treas., Robert L. Ware, Western Electric Co., Inc., 195 Broadway, New York.

Texas Cottonseed Crushers' Assn. Exec. Vice-Pres., A. L. Ward, 1411 Santa Fe Building, Dallas, Texas.

Textile Color Card Assn. of the United States, Inc., The. Sec. and Man. Director, Margaret Hayden Rorke, 200 Madison Ave., New York.

Tile Mfrs.' Assn., The. Sec., Stevenson, Jordan, and Harrison, 19 West 44th St., New York.

Tri-State Zinc and Lead Ore Producers Assn. M. D. Harbaugh, Picher, Okla.

UNION Internationale de Chimie. Sec., Jean Gerard, 49 Rue des Mathurins, Paris, France.

United States Alkali Export Assn., Inc. Pres., E. V. Finch, 11 Broadway, New York.

U. S. Potters' Assn. Sec.-Treas., Charles F. Goodwin, East Liverpool, Ohio.

U. S. Shellac Importers Assn., Inc. Sec., L. W. Babbage, 516 West 59th St., New York.

VEREIN Deutscher Chemiker, Berlin W. 35 Potsdamerstr. 103a.

Verein zur Wahrung der Interessen der chemischen Industrie Deutschlands E. V. Berlin W. 35, Regentenstr. 16.

WASHINGTON Academy of Science. Sec., Paul E. Howe, Bureau of Animal Industry, Washington, D. C.

Water Works Mfrs.' Assn. Sec., J. A. Kienle, 250 Park Ave., New York.

Western Petroleum Refiners Assn. Pres,. Howard Bennette, 607 Cosden Bldg., Tulsa, Okla.

Wood Chemical Institute. Sec.-Treas., J. A. McCormack, Exchange Bank Bldg., Olean, N. Y.

ZINC Export Assn., Inc., Mgr., E. V. Gent, 500 Fifth Ave., New York.

Where Plants Are Being Built in Process Industries

	Current Projects	
	Proposed Work and Bids	Contracts Awarded
New England	$29,000	.....
Middle Atlantic	588,000	$178,000
Southern	1,229,000	50,000
Middle West	28,000	58,000
West of Mississippi	1,679,000	56,000
Far West	75,000	10,000
Canada	313,000	60,000
Total	$3,941,000	$412,000

NEW CONSTRUCTION

PROPOSED WORK BIDS ASKED

Chemical Plant—Gladman Chemicals, Ltd., C. Caven Herald, Pres., Gladman, Sask., plans to develop a sodium sulphate plant here. Estimated cost $200,000.

Chemical Plant — Louisiana Products Corp., Shreveport, La., plans the construction of a chemical plant near Winnfield, La. First unit for the development of lime to cost $600,000, to be followed by units for calcium chloride, and sodium sulphate.

Chemical Plant—Williams Chemical Co., Russell, Ont., plans the construction of a chemical plant. Estimated cost $28,000.

Patent Medicine Plant—G. C. Hanford Manufacture, Ltd., 215 St. Paul St., W., Montreal, Que., manufacturer of patent medicines, plans the construction of a plant. Estimated cost $35,000.

Distillery—A. G. Barker, Vincentown, N. J., contemplates the construction of a distillery. Estimated cost $50,000.

Distillery—Bonnie Bros., 34th and Bank Sts., Louisville, Ky., contemplate the construction of a distillery. Estimated cost $75,000.

Distillery — Elkforge Distillery Corp., Elk Mills, Md., is having plans prepared by Ford, Bacon & Davis, Consult. Engrs., 39 Bway., New York, N. Y., for a distillery. Estimated cost $50,000.

Distillery—Kentucky Richland Distilling Co., Carrollton, Ky., is having plans prepared by Ford, Bacon & Davis, Consult. Engrs., 39 Bway., New York, N. Y., for distillery. Estimated cost $75,000.

Laboratory — Krebs Pigment & Color Corp., 2001 Bonhill Ave., Baltimore, Md., will soon take bids for the construction of a laboratory and office building. Estimated cost $30,000.

Laboratory—New Jersey State Highway Dept., Trenton, N. J., plans to build a testing laboratory at Fernwood, 3 mi. from Trenton. Estimated $50,000.

Laboratory—Standard Oil Co. of New York, 26 Bway., New York, N. Y., is having plans prepared by D. Wortman, Archt., 109 East 29th St., New York, for altering its plant and laboratory at Kingsland and Greenpoint Aves., Brooklyn, N. Y. New equipment will be installed. Estimated cost $28,000.

Laboratory — State of Maryland and U. S. Treasury Dept., Procurement Division, Washington, D. C., is having plans prepared by Henry P. Hopkins, 10 East Mulberry St., Baltimore, Md., for the construction of a laboratory at the College of Mines, University of Maryland, College Park. Estimated cost $350,000.

Laboratories — University of Virginia, Charlottesville, Va., had plans prepared for group of engineering buildings including a 1 story gas and steam laboratory building. Arrangements are also being made for establishment of laboratories for teaching aero-dynamics, electrical engineering and metallurgical work. Walter D. Blair, 154 East 61st St., New York, N. Y., R. E. Lee Taylor, Baltimore Trust Bldg., Baltimore, Md., J. K. Peeble, Norfolk and E. S. Campbell of University's School of Art and Architecture, designed buildings. Estimated cost $379,000.

Lead Factory—Flemm Lead Co., 31st Pl. and Bradley Ave., Long Island City, N. Y., is having plans prepared by J. Baker, Archt., 10-09 Jackson Ave., Long Island City, for altering its factory, including the installation of new equipment. Estimated cost $30,000.

Leather Factory—Franke Tanning & Manufacturing Co., New Braunfels, Tex., contemplates the construction of a leather manufacturing factory. Estimated cost $28,000.

Gas Plant—City, J. M. Schmidt, City Engr., Lewiston, Mont., plans the construction of a municipal gas plant. Federal funds applied for. Estimated cost $331,418.

Refinery—Omar Refinery Co., Garber, Okla., plans to alter the plant of the former Garber Refining Co. for its own use. Estimated cost $30,000.

Refinery — Sun Oil Co., 1608 Walnut St., Philadelphia, Pa., has obtained options on a site at Texas City, Tex., and plans to construct a refinery, tank farm and terminals. Estimated cost $250,000.

Cotton Oil Plant — Eastern Cotton Oil Co., Hertford, N. C., plans the construction of a cotton oil plant including a boiler unit. Estimated cost $100,000.

Roofing Plant—Tilo Roofing Co., Longbrook Ave., Stratford, Conn., has purchased the plant of the Spring Perch Co. at Stratford and is having plans prepared by Ernest G. Southey, Archt., 955 Main St., Bridgeport, Conn., for altering same for its own use for the manufacture of prepared roofing shingles. Estimated cost $28,500.

Rubber Factory — Trafalgar Rubber Co., Cooksville, Que., plans the construction of a rubber factory. Estimated cost $50,000.

Tire Factory—C. O. Henderson, Bucyrus, O., plans to alter plant for the manufacture of tires. New equipment will be needed. Estimated cost $28,000.

Tire Fabric Plant—Gates Rubber Co., 999 South Bway., Denver, Colo., plans the construction of a tire fabric plant in Denver or purchasing and reconditioning a fabric plant at some other location. Estimated cost $1,000,000.

Equipment—Climax Molybdenum Co., Climax, Colo., plans to install new type flotation and grinding machinery and new steam heating plant at its property. Estimated cost $40,000.

Equipment — Metals Recovery Corp., Reno, Nev., C. L. Cooper, Gen. Mgr., plans to purchase tube mills, classifiers and filters to enlarge its plant at Millers Farm from 650 tons to 1,200 tons capacity. Estimated cost $75,000.

CONTRACTS AWARDED

Concentrating Plant — Paso Robles Concentrates Co., Los Angeles, Calif., awarded contract for 2 story, sulphur concentrating plant (capacity of approximately 1,000 gal. per month) at Paso Robles, Calif., to F. J. Faulstich, San Luis Obispo, Calif. Estimated cost $10,000.

Ore Development — Eagle Gold & Platinum Mining Co., c/o Norman McCormick, Tulameen, B. C., plans to develop gold and platinum deposits at various locations in British Columbia. Owner will purchase materials and do work by day labor. Estimated cost $60,000.

Dryer — Minnesota Mining & Manufacturing Co., Forest and Farquier Sts., St. Paul, Minn., awarded contract for dryer to Wm. Murphy & Son, 1607 Pioneer Bldg., St. Paul; structural steel for same to Wausau Iron Works, Wausau, Wis.

Factory — Philadelphia Storage Battery Co., Ontario and C Sts., Philadelphia, Pa., awarded contract for addition to factory, to Stewart Bros. Co., 3509 North 10th St., Philadelphia. Estimated cost $150,000.

Dry Ice Plant—Liquid Carbonic Co., 3100 South Kedzie Ave., Chicago, Ill., awarded contract for dry ice building for distillery at foot of Edmunds Ave., Peoria, Ill., to V. Jobst & Sons, Lehman Bldg., Peoria.

Coke Plant — Illinois Steel Co., Gary, Ind., awarded contract for reconditioning and rebuilding by-product coke batteries, to Wilputte Coke Oven Corp., 400 Madison Ave., New York, N. Y. Estimated cost $30,000.

Fertilizer Plant—Tennessee Valley Authority, Knoxville, Tenn., awarded contract for experimental fertilizer plant, addition to Nitrate Plant No. 2, to Stone & Webster, Engineers and Contractors, 90 Broad St., New York, N. Y. D. C. Powers is local construction superintendent. Estimated cost $50,000.

Vapor Recovery Plant—Phillips Petroleum Co., Bartlesville, Okla., awarded contract for concrete work for vapor recovery plant for refinery, to Austin Co., Arcade Bldg., St. Louis, Mo. Estimated cost $27,500.

Soap Powder Factory—American Soap Powder Works, 100 Van Dyke St., Brooklyn, N. Y., awarded contract for altering its factory, including new spray chamber, to Hassler Iron Works, 55 Mill St., Brooklyn, N. Y. Estimated cost $28,000.

CRESYLIC ACID

Year	Production Lb.	Imports Lb.	Exports	Average Price Lb.
1923	.....	685,009	.....	$1.135
1927	.....	9,136,516	.....	0.65
1929	14,601,534	17,856,765	.....	0.6475
1931	.....	.....	.....	0.54
1932	.....	.....	.....	0.49
1933	.....	.....	.....	0.44

Manufacturers: American Tar Products, Pittsburgh; Barrett Co., N. Y. City; Carnegie Steel Co., Pittsburgh; Reilly Tar & Chem. Corp., Indianapolis.

FERRIC FERROCYANIDE (Prussian Blue)

Year	Production Lb.	Imports	Exports	Average Price Lb.
1923	3,915,777	.....	.....	51.5c.
1927	4,104,233	.....	.....	32.00c.
1929	4,803,419	.....	.....	34.17c.
1931	3,506,912	.....	.....	34.70c.
1932	.....	.....	.....	34.60c.
1933	.....	.....	.....	35.00c.

Uses: paint, varnish, paper, laundry blue, match head compositions, dyeing.

Manufacturers: Ansbacher-Siegle Corp., N. Y. City; J. S. & W. R. Eakins, Brooklyn; Ford Paint & Varnish Co., Grand Rapids; Harmon Color Works, Brooklyn; Heller & Merz, Newark, N. J.; Imperial Color Works, Glens Falls, N. Y.; Kentucky Color & Chem. Co., Louisville; H. Kohnstamm & Co., N. Y. City; Fred L. Lavanburg Co., N. Y. City; Pittsburgh Plate Glass Co., Milwaukee; Rising Sun Color Works, Phila.; Sherwin-Williams Co., Cleveland; Sun Chemical & Color Co., Harrison, N. J.; United Color & Pigment Co., Newark, N. J.; Utility Color & Chem. Co., Newark, N. J.; Western Dry Color Co., Chicago.

PHOSPHATE ROCK

Year	Production Long Tons	Imports Long Tons	Exports Long Tons	Average Price Hard Rock f.o.b. mine, Long Tons
1923	2,943,566	6,725	827,551	$5.37
1927	3,025,149	28,195	918,211	4.00
1929	3,821,840	44,899	1,142,746	3.69
1931	2,577,535	13,496	951,305	6.65
1932	1,739,197	12,982	613,035	6.48
1933	.....	.....	.....	....

Grades: hard, soft, land pebble.

Uses: superphosphates, phosphates, phosphoric acid, ferrophosphorus, direct soil application, fertilizer filler, stock and poultry feed.

Producers: Florida—Amalgamated Phosphate Co., Brewster; American Ag. Chem. Co., Pierce; J. Buttenbach & Co., Dunnellon and Hernando; C. and J. Camp, Dunnellon; Colloidal Phosphate Sales Co., Dunnellon; Coronet Phosphate Co., Pembroke, Plant City and Mulberry; International Ag. Corp., Mulberry; Lakeland Phosphate & Fertilizer Co.; Bartow; Phosphate Mining Co., Bartow, Christina, and Nichols; Southern Phosphate Corp., Eaton Park and Lakeland; Swift & Co., Fort Meade. Idaho—Anaconda Copper Mining Co., Conda. Montana—William Anderson, Garrison; Garrison Mining & Phosphate Co., Deer Lodge; Northwestern Improvement Co., Elliston; Washington Phosphate & Silver Co., Maxville. Tennessee—Armour Fert. Wks., Columbia; Charleston Mining Co., Gordonsburg and Mount Pleasant; J. K. Davis, Mount Pleasant; Federal Chem. Co., Century, Ridley, and Southport; Harsh Phosphate Co., Nashville; Hoover & Mason Phosphate Co., Mount Pleasant; International Ag. Corp., Mount Pleasant and Wales; J. J. Jones, Mount Pleasant; S. T. Jones, Mount Pleasant; Ligon & Huff, Southport; George Owens, Mount Pleasant; Tennessee-Illinois Phosphate Co., Twomey. Wyoming—Cokeville Phosphate Co., Cokeville.

LINSEED OIL

Year	Production Lb.	Imports Lb.	Exports Lb.	Average Price Tanks, Lb.
1923	653,563,868	43,096,714	3,013,216	12.99c.
1927	776,714,498	946,432	2,525,240	9.64c.
1929	763,576,494	9,960,961	2,208,305	11.56c.
1931	520,735,372	235,492	1,094,261	8.48c.
1932	326,569,465	25,243	842,297	5.60c.
1933	.....	.....	.....	8.43c.

Uses: paint, varnish, linoleum, oilcloth, patent and imitation leather, printing ink, foundry oils, putty, soft soaps.

Producers: Archer-Daniels-Midland Co., Minneapolis; Brown Linseed Co., Port Richmond, N. Y.; Fredonia Linseed Oil Works, Fredonia, Kan.; Spencer Kellogg & Sons, Buffalo; John T. Lewis & Bro., Phila.; Mann Bros., Buffalo; Minnesota Linseed Oil Co., Minneapolis; National Lead Co., N. Y. City; Pittsburgh Plate Glass Co., Pittsburgh; Portland Linseed Oil Works, Portland, Ore.; Sherwin-Williams Co., Cleveland.

HYDROGEN PEROXIDE

Year	Production Lb.	Imports Lb.	Exports Lb.	Average Price Basic 100 vol.
1923	25,006,182	.....	.....	34c.
1927	21,442,651	371,855	.....	32c.
1929	8,508,649*	.....	.....	31c.
1931	12,853,651*	.....	1,319,743	27c.
1932	.....	.....	.....	20.5c.
1933	.....	.....	.....	20.5c.

*Reported on basic 100 vol.

Manufacturers: Barium Products, Ltd., Modesto, Calif.; John Bene & Sons, Brooklyn; Buffalo Electro-Chem. Co., Buffalo; Cardone Peroxide, Inc., Brooklyn; E. I. du Pont de Nemours & Co., Wilmington; J. H. R. Products Co., Willoughby, Ohio; Mallinckrodt Chem. Works, St. Louis; Merck & Co., Rahway, N. J.; Oakland Chem. Co., N. Y. City; Peroxide Chem. Co., St. Louis; Warner Chem. Co., N. Y. City.

Plants, 12: N. Y., 5; Mo., 2; N. J., 2; Calif., Pa., R. I., 1 each.

MERCURY

Year	Production Flasks, 76 Lb.	Imports Fl., 76 Lb.	Exports Fl., 76 Lb.	Average Price Fl., 76 Lb.
1923	7,833	17,836	314	$66.50
1927	11,128	19,941	.....	118.16
1929	23,682	14,917	.....	122.15
1931	24,947	549	4,984	87.35
1932	12,622	3,886	214	57.93
1933	.....	.....	.....	.....

Uses: chemicals, drugs, ammunition, mercury boilers, scientific instruments, electrical apparatus.

Producers: California—Acme Mines & Mill, San Francisco; Consolidated Metals Corp., Cambria; Knoxville Mine, Knoxville; Lucky Strike Mining Co., San Francisco; Mercury Corp. of Amer., Santa Margarita; Mercury Mining Syndicate, San Francisco; Mercy Mine, Los Palos; Mirabel Mine, Middletown; Newhall Mine, San Francisco; New Idria Quicksilver Mines, San Francisco; Red Elephant Mine, Rieff; Sulphur Bank Syndicate, San Francisco. Nevada—Antelope Springs Mercury Mines, Lovelock; B & B Quicksilver Co., Basalt; Cardinal Mine, Mina; Castle Peak Quicksilver Co., Virginia City; Nevada Quicksilver Mines, Lovelock; Pershing Quicksilver Co., Lovelock; Raymond Van Ness Co., Tonopah; Steamboat Springs Mine, Steamboat Springs. Oregon—Consolidated Quicksilver Co., Prineville; Quicksilver Syndicate, Blackbutte. Texas—Brewster Quicksilver Consolidated, Terlingua; Chisos Mining Co., Terlingua; Rainbow Mines, San Antonio. Washington—Consolidated Mercury Mining Co., Tacoma; Morton Cinnabar Co., Morton.

New Data on Chemical Raw Materials for Process Industries

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Continued from editorial supplement to January *Chem. & Met.*